

Appendix D - Storm Water Source Control and Treatment Measure Design Update

Portland Facility
Portland, Oregon

June 2015

Prepared for:
Vigor Industrial, LLC

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Project No. 0272376



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LIST OF ACRONYMS

µg/L	Microgram(s) per liter
BEHP	Bis(2-ethylhexyl)phthalate
BES	Bureau of Environmental Services
BMP	Best management practice
BWTP	Ballast Water Treatment Plant
DGI	Data gap investigation
DMR	Discharge Monitoring Report
EC	Electrocoagulation
EQ	Exceedance quotient
ERM	ERM-West, Inc.
JSCS	Joint Source Control Strategy
NPDES	National Pollutant Discharge Elimination System
ODEQ	Oregon Department of Environmental Quality
ODOT	Oregon Department of Transportation
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
SCM	Source control measure
SCSE	Source control screening evaluation
SLV	Screening Level Value
SWPCP	Storm Water Pollution Control Plan
TBT	Tributyltin
TSS	Total suspended solid
USEPA	United States Environmental Protection Agency

This Storm Water Source Control and Treatment Measure Design Update Report was prepared by ERM-West, Inc. (ERM) on behalf of Vigor Industrial, LLC (Vigor) for the Portland Facility, located at 5555 North Channel Avenue, Portland, Oregon (the Site). The purpose of this report is to present proposed interim source control and treatment measures and update to the design of storm water source control measures (SCMs) at the Site.

The SCMs are being implemented to control storm water as a potential contaminant pathway to the Willamette River. The storm water SCMs are intended to enable Vigor to meet the requirements for pollutant concentration reduction under the new National Pollutant Discharge Elimination System (NPDES) General Industrial Storm Water (1200-Z) permit for the Lower Willamette River.

The report has been prepared in accordance with the Oregon Department of Environmental Quality (ODEQ) and United States Environmental Protection Agency (USEPA) Portland Harbor Joint Source Control Strategy (JSCS) guidance document (ODEQ and USEPA 2005). This report will be included as an attachment to the Site Storm Water Pollution Control Plan (SWPCP).

2.0

STORM WATER SOURCE CONTROL MEASURES

Based on the conclusions of the SCSE and the Tier II requirements of the NPDES permit, the objectives for source control are as follows:

- Achieve NPDES Tier II zinc mass removal and concentration reduction requirements for Outfalls Q, O, and M by 30 June 2015
- Achieve NPDES permit benchmarks in storm water runoff across the Site; and,
- Prevent potential sediment recontamination by reducing the loading of arsenic, cadmium, copper, lead, zinc, polycyclic aromatic hydrocarbons (PAHs), bis-2-ethylhexyl-phthalate (BEHP), and tributyltin (TBT) in storm water discharging to the Willamette River.

2.1

PROPOSED SITE-WIDE STORM WATER MANAGEMENT

A summary of the source control evaluation conclusions and site-wide storm water management strategy, including the proposed SCM for each drainage area, is provided in Table 1. The specific conveyance re-routing and location of treatment measures are presented in Attachment A.

A proposed storm water SCM (south bioretention pond) was included in the March 2013 ODEQ-approved SWPCP update, as a required element of the NPDES permit. The proposed SCM is intended to achieve the Tier II requirements for Outfall Q, O, and M, including the portion outside of the boundary fence (i.e. North Lagoon Avenue). A summary of the areas included in the South Bioretention Pond is presented in Table 1. An updated design package for the South Bioretention Pond SCM is included in Attachment B. A phased approach to implementation of the SCM was presented in the Storm Water Source Control Measure Design Update (ERM 2014b), which was included in the ODEQ and City-approved December 2014 SWPCP update. The south Bioretention Pond is designed to eventually treat stormwater from approximately 60-percent of the site.

An EC system pilot study was conducted in 2013/2014 to evaluate EC as a potential storm water treatment technology at the site. Based on the results of the pilot study (ERM 2014b), Vigor proposed to utilize a full scale EC technology system to treat storm water from the remaining 40 percent of the site.

During south Bioretention Pond permitting and construction planning in April 2015, the planned phased implementation approach was revised to account for current site operational conditions and to take advantage of opportunities for significant cost savings associated with construction sequencing.

The revised phased approach for implementation of the South Bioretention Pond SCM and achieving compliance with the NPDES Tier II requirements consists of:

- **Phase 1 (Winter 2014/Spring 2015)** – (Revised) Interim measures in Outfall Q, O, and M that include: continued treatment of Outfall Q runoff using a 400 gallon-per-minute EC system; and application of additional BMPs (i.e. covering laydown materials with plastic, increased sweeping frequency) and installation of small scale interim treatment measures (i.e. Grattix boxes) at potential sources of zinc within the catchment areas of Outfalls O and M.
- **Phase 2 (Spring 2015)** – (Revised) Deployment of interim BMPs in North Lagoon Avenue, including closure to public access, limiting industrial activities in this area, covering laydown materials with plastic, and increased sweeping frequency.
- **Phase 3 (Fall 2015)** - Construction of the South Bioretention Pond SCM and associated infrastructure to connect Outfalls Q, O, and M to the Bioretention Pond.
- **Phase 4 (timing to be determined)** - Berth 313 and Berth 314 (Outfalls LD4-B through LD7B) reconveyance and connection to the South Bioretention Pond. Berth 303, 304, and 305 (Outfalls J through N, and N-1 to N-6) reconveyance and connection to the South Bioretention Pond.
- **Phase 5 (timing to be determined)** - Berth 312 (Outfalls LD1-A through LD4-A to EC treatment at BWTP).

The completion of Phases 1 and 2 are intended to meet the storm water treatment objectives and implementation schedule under the NPDES permit Tier II requirements. Completion of Phase 3 is intended to complete source control and continue meeting NPDES Tier II treatment objectives. Completion of Phases 4 and 5 are intended to complete source control for the Site in advance of the implementation the Portland Harbor sediment remedial action.

2.2

NDPES TIER II INTERIM SOURCE CONTROL AND TREATMENT MEASURES

Under the requirements of the NPDES permit, Vigor is required to implement additional measures at Outfalls Q, O, and M by 30 June 2015 with the goal of achieving the benchmarks of the permit. Vigor will utilize a combination of interim source control and treatment measures to achieve benchmarks at Outfalls Q, O, and M until the South Bioretention Pond SCM construction is completed. The locations of proposed interim source control and treatment measures are shown in Attachment A.

2.2.1

Outfall Q Interim Treatment Measure

As presented in the *Storm Water Source Control Measure Design Update* (ERM 2014), a pilot EC system has been operating at the facility since May 2013. The 400-gpm pilot EC system treats the stormwater runoff from the Outfall Q catchment area. Performance monitoring results are presented in Table 2. Following system shake down early in the monitoring period (since February 2014), the EC system has consistently achieved benchmark concentrations in the effluent, including zinc. It is anticipated that this interim treatment system will continue to achieve benchmarks, until it is removed following completion of the South Bioretention Pond SCM.

2.2.2

Additional Interim Roof Drain Treatment Measures

Vigor will install small scale interim treatment measures to directly treat roof drainage from Building 4 and Building 10, which were previously identified as potential sources of zinc to stormwater in Outfalls O and M (ERM 2010). These treatment measures include ion absorption and filtration media; and biofiltration devices (Grattix Boxes).

2.2.2.1

Storm Water Filtration

Vigor is deploying stormwater filtration devices containing MetalZorb® media. The MetalZorb® is a sponge media that removes metals in stormwater through filtration of solids and sorption of dissolved contaminants. The media will be placed in absorbent socks and deployed in stormwater drain lines around Building 4. The locations of the filtration devices are shown in Attachment A.

2.2.2.2

Grattix Boxes

A field trial of the “Grattix Box” system has been implemented at a roof drain in the Outfall R basin. The preliminary results of the field trial are

presented in Table 3. Applicable NPDES benchmarks were achieved in the effluent of the Grattix Box. Average concentration reductions in the effluent were: cadmium (70 percent); chromium (37 percent); copper (82 percent); lead (92 percent); and zinc (98.5 percent). Increases in aluminum, iron, and nickel were observed, however average concentrations were below NPDES benchmarks.

The results indicate that contaminants, specifically zinc, in this and other basins with effluent primarily or solely from roof drainage can be controlled through the use of individual roof drain treatment systems. The locations of Grattix Boxes installed at roof drain downspouts are presented in Attachment A. Estimated contaminant removal efficiencies are presented in Table 4.

2.2.2.3 *Catch Basin Biofiltration Inserts*

Catch basins around Building 4 discharge to conveyance lines that tie directly to Outfall O and comingle with off-site street runoff. Due to configuration of the drain lines, it is not possible to treat the onsite runoff prior to mixing with the street runoff. These affected catch basins will be retrofitted with biofiltration inserts, as shown in Attachment A.

The biofiltration inserts are based on the Grattix Box design. They are installed directly in the catch basin, with compost/sand media underlain by gravel and contained within a geotextile. Due to the limited catchment sizes, low flows observed from these catch basins, and Grattix Box performance data, the biofiltration inserts are anticipated to achieve the zinc benchmark in discharge from this area. The catch basin inserts will be removed following completion of the bioretention pond and reconveyance construction.

2.2.3 *Additional Interim Best Management Practices*

Vigor has intensified the use of BMPs throughout the Outfall O and M catchment areas. This effort is focused on reducing the source of zinc to runoff in these active areas of the site. Additional BMPs that have been implemented include:

- Covering materials coated with zinc primer, such as metal plates, with plastic to prevent rain from contacting the equipment; and
- Increased sweeping frequency from monthly to weekly.

These BMPs will reduce the source of zinc to stormwater

2.3

SOURCE CONTROL MEASURE DESIGN BASIS

The objective of the proposed permanent SCMs (Bioretention Pond, EC System, roof drain treatment systems, and LID facilities) is to prevent sediment recontamination of Willamette River sediments following sediment remediation in the Portland Harbor Superfund Site by reducing the loading of contaminants requiring source control in storm water discharging to the Willamette River. In addition to reducing storm water discharge volume, the goal of the SCMs is also to reduce concentrations of contaminants in storm water to NPDES benchmark levels.

2.2.1

Source Control Measure Design Basis

There are no established source control criteria or effluent concentrations for storm water to prevent recontamination of sediment. Additionally, there is no established design storm for the purpose of sizing treatment facilities to achieve source control. Several agencies, including the City of Portland and the Oregon Department of Transportation (ODOT) have established design storms for storm water quality. An evaluation of these design storms was presented in the *Infiltration Pond Sizing Analysis* (ERM 2013a).

The City of Portland and ODOT water quality design storms are backed by rigorous analysis with the objective of achieving a high degree of runoff capture (City of Portland 2007; ODOT 2008). The goal in selecting the design storm is to provide sufficient capture such that both NPDES permit benchmarks and Portland Harbor source control objectives are achieved, while accommodating the severe space restrictions in place at the Site. A storm water model was developed to evaluate the performance of the proposed design basis of the South Bioretention Pond SCM.

The rainfall-runoff for the Site was modeled using the USEPA's Storm Water Management Model in order to evaluate the expected performance of various proposed design storms. The effectiveness of the South Bioretention Pond, when sized to treat the ODOT design storm (1.25 inches in 24 hours), was tested by modeling the actual hourly rainfall record for 1948 through 2012 (64 years). The runoff volume in excess of the pond volume is discharged through an engineered high flow bypass during extreme events. The rainfall record evaluation indicated that approximately 93 percent of storm water was treated when using a facility sized to treat the 1.25 inch storm. Increases in design storm sizes beyond 1.2 inches resulted in comparatively lower increases in treatment volume (ERM 2013a).

The ODEQ has approved a design storm of 1.25 inches as an appropriate design storm size for the purpose meeting source control at the Site. Vigor is proposing to use the 1.25 inch storm as the design basis for both the South Bioretention Pond, and the full scale EC system. Modeled storm water runoff volumes for the 1.25-inch design storm are presented in Attachment C. The subsequent hydraulic design of Phase 3 is presented in Attachment D.

2.2.2

NPDES Tier II Contaminant Concentration Reduction

In order to meet the NPDES Tier II requirements, an effluent concentration target must be achieved. The proposed SCMs consist of systems that treat and then discharge treated effluent, which requires an effluent concentration target to be achieved in order to comply with NPDES permit benchmarks (e.g., 120 µg/L for zinc). For the purpose of meeting the current Tier II requirements, the runoff from Outfalls Q, O, and M is required to be treated to achieve the zinc benchmark. Zinc is currently the only constituent with a Tier II contaminant concentration reduction requirement.

In order to evaluate the feasibility of the proposed SCMs to achieve the zinc benchmark, estimated treatment efficiencies were applied to the combined annual runoff volume and average zinc concentrations (calculated from the DGI data) for each outfall that contributes to each of the SCMs.

The estimated zinc reductions feasible for each of the proposed SCMs were obtained through literature review, including the *International Stormwater BMP Database Pollutant Category Summary Statistical Addendum* (Geosyntec and Wright 2012), from the EC pilot study performance data, and from the Grattix Box pilot study. Estimated zinc removal efficiencies for the proposed SCMs and treatment facilities are presented in Tables 2, 3, and 4.

The concentrations of zinc observed in Outfall Q runoff are higher by approximately an order of magnitude than the influent concentrations observed in many published studies of treatment system performance (Geosyntec and Wright 2012). Studies that evaluated bioretention system treatment of zinc at similar levels to those observed at Outfall Q (600 – 2,000 µg/L) reported consistent zinc removal efficiencies in excess of 98 percent, with effluent concentrations usually below 25 µg/L (Davis et al 2003). For the purpose of estimating effluent concentrations, a treatment efficiency of 95 percent was assumed for the bioretention pond.

This removal efficiency is based on the removal efficiencies observed in the EC system pilot study presented in Table 2

High zinc removal efficiency has been achieved in the bioretention pond operating at the Port of Vancouver, Washington, facility since 2012. This bioretention pond has successfully treated storm water to below benchmarks consistently, such that a monitoring waiver has been applied on the basis of the lack of exceedances. The Port of Vancouver has similar industrial activities, rainfall conditions, and catchment sizes as the Vigor facility. Similar treatment results are anticipated at the proposed South Bioretention Pond SCM.

Calculated combined effluent concentrations and the estimated annual zinc mass removal from each of the proposed SCMs are presented in Table 5. As shown in Table 5, based on the estimated removal efficiencies, the combined effluent flow from the South Bioretention Pond that will capture runoff from the current NPDES Tier II outfalls (Q, O, and M) is anticipated to have a zinc concentration that is below the NPDES permit benchmark.

The estimated effluent zinc concentrations from the bioretention pond, EC System, and Grattix boxes (including biofilters) are also below the NPDES permit benchmark for outfalls.

2.2.3 *Source Control Mass Reduction*

The objective of source control is to reduce the mass flux of contaminants to the Willamette River in order to prevent recontamination of sediment. By removing the contaminants from the storm water flow, the proposed SCMs will reduce the mass of contaminants discharging from the Site in storm water. Estimated removal efficiencies for each identified source control contaminant and the proposed SCMs are presented in Table 4.

The average annual rainfall of 42.85 inches was used to estimate annual contaminant mass removal rates for each proposed SCM, which are presented in Table 5.

The estimated annual total site-wide mass removal of contaminants is significant, ranging between 36 percent for cadmium (0.005 pounds) and 93 percent for zinc (30.3 pounds). Mass removal rates in these ranges are likely to significantly reduce or control the potential for sediment recontamination.

It should be noted that the estimated annual removal rates use the conservative assumption that contaminant concentrations are constant throughout a storm. The SCMs are designed to treat the initial part of storm events, including the first flush portion of the storm, which typically has higher concentrations of contaminants than the latter stages of the storm. Treating the first flush will remove a greater portion of the contaminant mass than estimated in Table 5.

3.0

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Tables

Table 1

Source Control Data Evaluation

Storm Water Source Control Measure Design Update

Storm Water Source Control Measures

Vigor Industrial, LLC

Outfall	NPDES Rep Outfall Group ¹	Current Activities Conducted in Drainage Zone	Compounds Requiring Source Control ²								Source Control Determination	Source Control Priority ³ Rationale	Proposed Source Control Action	Implementation Phase
			Catch Basin Sediment (2007)	Storm Water Discharge (2009)	Roof Sampling (2010)	Sediment Traps (2011)	NPDES Monitoring (2007 - 2010)	NPDES Monitoring (2011 - 2012)	Data Gaps Investigation (2013 - 2014)	SCSE Program (2007 - 2014)				
A	1	Staging area for vessels at berth; waste transfer from ships; heavy crane use.	--	--	--	--	--	--		Cu, Pb, Zn, Phthalates	Source control required based on representative Outfall G		EC System SCM	Phase 5
B	1	Staging area for vessels at berth; waste transfer from ships; heavy crane use.	As, Cu, Pb, Zn, PCBs, Phthalates, TBT	As, Cd, Cu, Pb, Zn, BEHP, PAHs	--	--	--	--		Cu, Pb, Zn, Phthalates	Source control required based on direct sampling and representative Outfall G		EC System SCM	Phase 5
C	1	Crane use; vehicle traffic.	--	--	--	--	--	--		Cu, Pb, Zn, Phthalates	Source control required based on representative Outfall G		EC System SCM	Phase 5
D	2	Roadway; craneway; laydown area; <10 day hazardous waste transfer facility area.	As, Cd, Cu, Pb, Zn, PCBs, BEHP, PAHs, TBT	--	Cu, Zn	--	--	--		Cu, Zn	Source control required, based on representative Outfall E		EC System SCM	Phase 5
E	2	Covered painting and blasting; roadway; craneway; administrative office space; parking lots; machinery and rolling stock repair and storage.	As, Cd, Cu, Pb, Hg, Zn, BEHP, PAHs, TBT	Cu, Pb, Zn, BEHP, PAHs, PCBs	Zn	As, Cd, Cu, Pb, Hg, Zn, BEHP, PCBs, TBT	Zn, Cu	Cu, Pb, Zn	Cu, Zn	Cu, Zn	Source control required based on direct sampling	Metals EQ > 10 & medium to high priority. PCBs low priority, TBT low priority. BMPs effective for PAHs, BEHP. As, Cd, BEHP low priority.	EC System SCM	Phase 5
F	1	Roadway; craneway; laydown area; <10 day hazardous waste transfer facility area.	As, Cd, Cu, Pb, Hg, Zn, PCBs, BEHP, PAHs, TBT	--	--	--	--	--		Cu, Pb, Zn, Phthalates	Source control required based on representative Outfall G		EC System SCM	Phase 5
G	1	Crane- and roadways; material laydown area (metal, wood, trailers).	--	--	--	--	--	Cu, Pb, Zn	Cu, Pb, Zn, BEHP	Cu, Pb, Zn, Phthalates	Source control required based on direct sampling	Metals EQs > 10 & medium to high priority, BEHP EQ > 10 & medium priority based on high Detection limits. As, Cd low priority.	EC System SCM	Phase 5
H	1	Crane- and roadways; material laydown area (metal, wood, trailers).	--	--	--	--	--	--		Cu, Pb, Zn, Phthalates	Source control required based on representative Outfall G		EC System SCM	Phase 5
I	3	Crane-, rail- and roadways; equipment and material laydown area; indoor substation.	--	--	Zn	--	--	--	--	Cu, Pb, Zn, TBT, Phthalates	Source control required based on representative Outfall S.		EC System SCM	Phase 5
J	1	Crane-, rail- and roadways; equipment and material laydown area (metal, wood).	--	--	Zn	--	--	--		Cu, Pb, Zn, Phthalates	Source control required based on representative Outfall G		South Bioretention Pond SCM	Phase 3
J1	1	Crane-, rail- and roadways; equipment and material laydown area (metal, wood).	--	--	--	--	--	--		Cu, Pb, Zn, Phthalates	Source control required based on representative Outfall G		South Bioretention Pond SCM	Phase 3
J2	1	Crane-, rail- and roadways.	--	--	--	--	--	--		Cu, Pb, Zn, Phthalates	Source control required based on representative Outfall G		South Bioretention Pond SCM	Phase 3
J3	1	Crane-, rail- and roadways.	--	--	--	--	--	--		Cu, Pb, Zn, Phthalates	Source control required based on representative Outfall G		South Bioretention Pond SCM	Phase 3
K	3	SE Building 10; provides roof drainage.	--	--	Zn	--	--	--	--	Cu, Pb, Zn, TBT, Phthalates	Source control required based on representative Outfall S.		South Bioretention Pond SCM or Grattix Boxes	Phase 3
L	6	Fiber optic cable and miscellaneous equipment storage for Tyco vessel Global Sentinel at B304; parking, rail-, crane- and roadways; steel laydown.	As, Cd, Cu, Pb, Zn, BEHP, PAHs, TBT	As, Cu, Pb, Zn, BEHP, PAHs	Zn	As, Cd, Cu, Pb, Hg, Zn, BEHP, PAHs, PCBs, TBT	--	Cu, Pb, Zn	Cu, Zn, BEHP, PAHs	Cu, Pb, Zn, Phthalates, PAHs	Source control required based on direct sampling	Metals EQs > 10 & high priority, high DL. BEHP EQs >10 & medium priority, Total PAHs medium priority. As, Cd low priority.	South Bioretention Pond SCM	Phase 3
L1	3	Fiber optic cable and miscellaneous equipment storage for Tyco vessel Global Sentinel at B304; parking, rail-, crane- and roadways; steel laydown.	--	--	--	--	--	--	--	Cu, Pb, Zn, TBT, Phthalates	Source control required based on representative Outfall S.		South Bioretention Pond SCM	Phase 3
*M	4	Rail- and roadways; steel fabrication; indoor/covered coating; parts cleaning; outside materials storage; vehicle traffic; indoor paint/solvent storage.	As, Cd, Cu, Pb, Hg, Zn, PCBs, BEHP, PAHs, TBT	Cu, Pb, Zn, PAHs	Cu, Zn	--	--	Cu, Pb, Zn	Cu, Zn	As, Cd, Cu, Zn, Phthalates	Source control required based on direct sampling and representative sample Outfall Q	Cu and Zn low to medium priority. BMPs working for Pb, PCBs, PAHs, and BEHP low priority.	Interim BMPs and treatment measures, follow by South Bioretention Pond SCM	Phase 3

Table 1

Source Control Data Evaluation
Storm Water Source Control Measure Design Update
Storm Water Source Control Measures
Vigor Industrial, LLC

Outfall	NPDES Rep Outfall Group ¹	Current Activities Conducted in Drainage Zone	Compounds Requiring Source Control ²								Source Control Determination	Source Control Priority ³ Rationale	Proposed Source Control Action	Implementation Phase
			Catch Basin Sediment (2007)	Storm Water Discharge (2009)	Roof Sampling (2010)	Sediment Traps (2011)	NPDES Monitoring (2007 - 2010)	NPDES Monitoring (2011 - 2012)	Data Gaps Investigation (2013 - 2014)	SCSE Program (2007 - 2014)				
M1	2	Crane- and major roadways; parking; material laydown area (metal, wood, trailers).	--	--	Cu, Zn	--	--	--	Cu, Pb, Zn	Cu, Zn	Source control required based on direct sampling and representative Outfall E.	Metals EQ > 10 & high priority. Average As, Cd, Pb low priority.	South Bioretention Pond SCM	Phase 3
N	3	Covered and Secured Chemical Storage; Roadway. Previous Use: Floating home construction.	As, Cd, Cu, Pb, Zn, BEHP, PAHs, TBT	As, Cu, Pb, Zn, PAHs	Cu, Zn	--	--	--	As, Cu, Zn, PAHs	As, Cu, Pb, Zn, PAHs	Source control required based on direct sampling and representative Outfall S	Metals EQs > 10 & high priority, BEHP low priority, PAHs medium to high priority.	South Bioretention Pond SCM	Phase 3
N1	1	Parking and roadway	--	--	--	--	--	--	As, Cu, Pb, Zn	As, Cu, Pb, Zn, Phthalates	Source control required based on direct sampling and representative Outfall G	Metals EQs > 10 & high priority, PCBs low priority.	Low Impact Development Treatment Facilities	Phase 4
N2	1	Parking and roadway	--	--	--	--	--	--		Cu, Pb, Zn, Phthalates	Source control required based on representative Outfall G		Low Impact Development Treatment Facilities	Phase 4
N3	1	Parking and roadway	--	--	--	--	--	--		Cu, Pb, Zn, Phthalates	Source control required based on representative Outfall G		Low Impact Development Treatment Facilities	Phase 4
N4	1	Parking and roadway	--	--	--	--	--	--		Cu, Pb, Zn, Phthalates	Source control required based on representative Outfall G		Low Impact Development Treatment Facilities	Phase 4
N5	1	Parking and roadway	--	--	--	--	--	--	Zn	Cu, Pb, Zn, Phthalates	Source control required based on direct sampling and representative Outfall G	Zn EQs > 10 & high priority, PCBs low priority.	Low Impact Development Treatment Facilities	Phase 4
N6	1	Parking and roadway	--	--	--	--	--	--	None	Cu, Pb, Zn, Phthalates	Source control required based on direct sampling and representative Outfall G	BEHP & Cu, Pb, Zn high priority at representative Outfall G and similar Outfalls N1 and N5)	Low Impact Development Treatment Facilities	Phase 4
*O	4	Main roadways - heavy vehicle traffic; steel fabrication, stainless steel fabrication; welding; administrative offices.	As, Cd, Cu, Pb, Hg, Zn, Phthalates, PAHs, TBT	Cu, Pb, Zn, PAHs	None	--	--	--	--	As, Cd, Cu, Zn, Phthalates	Source control required based on representative Outfall Q		Interim BMPs and treatment measures, follow by South Bioretention Pond SCM	Phase 3
*P	5	Employee parking lot.	--	--	--	--	--	--	None	None	Excluded from source control as area is separated from industrial activities and all contaminants are in the low priority range.	As, Cd, Cu, Pb, Zn low priority.	None	
Q	4	Parking lots and roadways; administrative offices; central utility boiler; indoor/covered painting and blasting; covered, secured and bermed 90-day hazardous waste storage area; facility materials recycling, transfer and consolidation area; main paint/solvent	As, Cd, Cu, Pb, Hg, Zn, BEHP, PCBs, PAHs, TBT	As, Cu, Pb, Zn, BEHP, PAHs, TBT	Cu, Zn	--	Zn, Cu	Cu, Pb, Zn	As, Cd, Cu, Zn, BEHP	As, Cd, Cu, Zn, Phthalates	Source control required based on direct sampling	Metals medium to high priority, BEHP high priority. Pb low to medium priority. TBT < SLV. PCBs and PAHs low priority.	EC is Interim SCM followed by South Bioretention Pond SCM	Phase 3
R	3	Roadways; parking; administrative offices; shipyard materials and equipment shipping and receiving; electrical equipment servicing; carpentry; covered parts/tools warehousing; metal fabrication; medical testing.	As, Cu, Pb, Zn, PAHs, TBT	Cu, Pb, Zn, BEHP, PAHs, PCBs	Cu, Zn	As, Cu, Pb, Zn, BEHP, PCBs, TBT		--	Cu, Zn, BEHP	Cu, Zn, Phthalates	Source control required based on direct sampling and representative Outfall S	Cu, Zn medium to high priority, BEHP EQs > 10 & medium priority. Total PAHs low to medium priority. TBT EQs < 10. PCBs low priority.	Individual roof drain Grattix box pilot test. If not effective, EC System SCM	Phase 5
R1	2	Roof drainage	--	--	--	--	--	--	Cu, Zn	Cu, Zn	Source control required based on direct sampling and representative Outfall E.	Cu, Zn high priority. TBT < SLV. PCBs and BEHP not detected.	Included in EC System SCM or Grattix Box	Phase 5
S	3	Roadway; parking; steam/pressure washing equipment machinery repair.	As, Cd, Cu, Pb, Hg, Zn, PCBs, Phthalates, PAHs, TBT	--	Cu, Zn	--	Zn, Cu	Cu, Pb, Zn	Cu, Pb, Zn, TBT, BEHP	Cu, Pb, Zn, TBT, Phthalates	Source control required based on direct sampling.	Metals medium to high priority. TBT detected above SLV consistently. PAHs low to medium priority. BEHP medium priority. As low priority. PCBs low priority.	EC System SCM	Phase 5

Table 1
Source Control Data Evaluation
Storm Water Source Control Measure Design Update
Storm Water Source Control Measures
Vigor Industrial, LLC

Outfall	NPDES Rep Outfall Group ¹	Current Activities Conducted in Drainage Zone	Compounds Requiring Source Control ²								Source Control Determination	Source Control Priority ³ Rationale	Proposed Source Control Action	Implementation Phase
			Catch Basin Sediment (2007)	Storm Water Discharge (2009)	Roof Sampling (2010)	Sediment Traps (2011)	NPDES Monitoring (2007 - 2010)	NPDES Monitoring (2011 - 2012)	Data Gaps Investigation (2013 - 2014)	SCSE Program (2007 - 2014)				
S1	5	Roadway; parking	--	--	--	--	--	--	Cu, Pb, Zn, TBT, BEHP	Cu, Pb, Zn TBT, Phthalates	Source control required based on direct sampling and representative Outfall LD-1B	Metals high priority. TBT detected consistently > SLV. BEHP medium priority. As, Cd low priority. PCBs and PAHs low priority.	EC System SCM	Phase 5
T	3	Roadway, vehicle traffic; Building 50 roof drainage.	As, Cd, Cu, Pb, Hg, Zn, BEHP, PAHs, TBT	--	None	--	--	--	--	Cu, Pb, Zn, TBT, Phthalates	Source control required based on representative Outfall S.		EC System SCM	Phase 5
LD-1A	5	Laydown area; roadway.	As, Cd, Cu, Pb, Zn, Phthalates, PAHs, TBT	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		EC System SCM	Phase 5
LD-1B	5	Laydown area; abrasive blast grit storage and distribution; roadway.	As, Cd, Cu, Pb, Zn, Phthalates, PAHs, TBT	--	--	--	--	Cu, Pb, Zn	Cu, Zn, BEHP	Cu, Zn, Phthalates	Source control required based on direct sampling	Metals EQs > 10 & medium to high priority. BEHP medium to high priority. As, Cd low priority. TBT EQs < 10.	EC System SCM	Phase 5
LD-2A	5	Laydown area; administrative office; roadway.	--	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		EC System SCM	Phase 5
LD-2B	5	Laydown area; roadway.	--	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		EC System SCM	Phase 5
LD-2C	5	Laydown area; roadway.	--	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		EC System SCM	Phase 5
LD-3A	5	Laydown area; roadway.	--	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		EC System SCM	Phase 5
LD-3B	5	Laydown area; roadway; covered special waste holding area.	As, Cd, Cu, Pb, Zn, Phthalates, PAHs, TBT	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		EC System SCM	Phase 5
LD-3C	5	Laydown area; roadway; covered special waste holding area.	As, Cd, Cu, Pb, Zn, Phthalates, PAHs, TBT	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		EC System SCM	Phase 5
LD-4A	5	Laydown area; administrative office; roadway.	--	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		EC System SCM	Phase 5
LD-4B	5	Laydown area; roadway.	--	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		South Bioretention Pond SCM	Phase 3
LD-4C	5	Laydown area; roadway.	--	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		South Bioretention Pond SCM	Phase 3
LD-5A	5	Laydown area; roadway.	--	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		South Bioretention Pond SCM	Phase 3
LD-5B	5	Laydown area; roadway.	--	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		South Bioretention Pond SCM	Phase 3
LD-5C	5	Laydown area; roadway.	--	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		South Bioretention Pond SCM	Phase 3

Table 1

Source Control Data Evaluation

Storm Water Source Control Measure Design Update

Storm Water Source Control Measures

Vigor Industrial, LLC

Outfall	NPDES Rep Outfall Group ¹	Current Activities Conducted in Drainage Zone	Compounds Requiring Source Control ²							Source Control Determination	Source Control Priority ³ Rationale	Proposed Source Control Action	Implementation Phase	
			Catch Basin Sediment (2007)	Storm Water Discharge (2009)	Roof Sampling (2010)	Sediment Traps (2011)	NPDES Monitoring (2007 - 2010)	NPDES Monitoring (2011 - 2012)	Data Gaps Investigation (2013 - 2014)	SCSE Program (2007 - 2014)				
LD-6A	5	Laydown area; administrative office; roadway.	--	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		South Bioretention Pond SCM	Phase 3
LD-6B	5	Laydown area; roadway. Previous use: Coal Cobb truck holding area and roadway.	--	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		South Bioretention Pond SCM	Phase 3
LD-7A	5	Laydown area; roadway.	--	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		South Bioretention Pond SCM	Phase 3
LD-7B	5	Laydown area; roadway.	--	--	--	--	--	--		Cu, Zn, Phthalates	Source control required, based on representative Outfall LD-1B		South Bioretention Pond SCM	Phase 3
UT-1	NA	Utility tunnel drain	--	--	--	--	--	--		--	Not a storm water outfall		--	
UT-2	NA	Utility tunnel drain	--	--	--	--	--	--		--	Not a storm water outfall		--	

Notes:

* = Drainage basin information is for Cascade General owned property only; City of Portland owned property/catch basins are not included.

-- = Not Sampled

EQ = Exceedance Quotient

NPDES = National Pollutant Discharge Elimination System

SCM = Source Control Measure

SLV = Screening Level Value

SCSE = Source Control Screening Evaluation

EC = Electrocoagulation

1 = Representative outfalls based on *Vigor Industrial Portland Facility - Determination of Representative Storm Water Outfalls* (ERM 2011) and ODEQ personal communication 28 November 2012.

2 = The determination for source control is based on the results of the Stormwater Source Control Screening Evaluation, including a comparison to JSCS SLVs and weight of evidence evaluation

3 = Priority for source control determined from comparison to *Guidance for Evaluating the Stormwater Pathway at Upland Sites: Appendix E: Tool for Evaluating Stormwater Data* (ODEQ 2010)

Chemical Key

As	Arsenic
Cd	Cadmium
Cr	Chromium
Cu	Copper
Hg	Mercury
Ni	Nickel
Pb	Lead
Zn	Zinc
BEHP	bis(2-ethylhexyl)phthalate
PCB	Polychlorinated Biphenyls
PAH	Polycyclic Aromatic Hydrocarbons
TBT	Tributyltin

Table 2
Electrocoagulation System Pilot Study Analytical Results
Storm Water Source Control Measure Design Update
Storm Water Source Control Measures
Vigor Industrial, LLC

Analyte	Unit	NPDES Benchmark	NPDES Reference Concentration	JSCH SLV	OUTFALL Q											Average
					Date		4/4/2013	5/1/2013	9/27/2013	1/7/2014	2/19/2014	3/28/2014	4/23/2014	6/12/2014	7/23/2014	
					Sample Type	DGI/NPDES	PS	DGI/NPDES	DGI/NPDES	PS	PS	N	DGI/NPDES	DGI/NPDES	SW #3 Pre-EC	
Sample ID	OUTFALL-Q-040413	NFLUENT_COMP_05011	OUTFALL-Q-092713	OUTFALL-Q-PRE EC 1/7/	OUTFALL-Q-PRE EC 2/19/	OUTFALL-Q-PRE EC 032820	OUTFALL-Q-PRE EC 042320									
Metals																
Aluminum	ug/L	750		200	295	203	153	2570	159	497	204	800	105	554		
Arsenic	ug/L		0.045	< 2.00	0.934	1.66	2.16	< 1.00	1.43	1.1	3.58		1.546			
Cadmium	ug/L		0.094	0.578	0.322	0.522	1.13	< 2.00	0.356	0.2	0.989	1.03	0.581			
Chromium	ug/L		100	4.62	3.32	2.17	16.7	1.94	6.27	2.46	9.59	1.9	5.44			
Copper	ug/L	20		2.7	95	107	43.3	290	32	96.8	34.7	255	110	118.2		
Iron	ug/L	1000			1760 Q	894	624	16000	1210	6880	1200	5760	1170	3944		
Lead	ug/L	40	0.54	9.93	27.7	3.93	23.7	3.9	7.28	4.43	19.5	2.4	11.42			
Mercury	ug/L		0.77	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.05	< 0.05	< 0.05	0.12	0.04			
Nickel	ug/L		16	5.4	4.44	3.56	20	2.92	7.81	2.88	11.8	6.39	7.24			
Selenium	ug/L		5	< 2.00	< 2.00	< 1.00	0.533	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.63		
Zinc	ug/L	120	36	1710	889	1710	3330	1050	1910	1260	3650	2970	2053.2			
Tributyltin	ug/L		0.072	< 0.050	< 0.050	< 0.0050	0.059	0.011	0.02	0.034	0.14		0.08			
PCBs																
Aroclor 1016	ug/L		0.96	< 0.00935 UQ	< 0.0206	< 0.00943	< 0.0196	< 0.00952	< 0.00980	< 0.0971	< 0.00943	< 0.0208	0.0114			
Aroclor 1221	ug/L		0.034	< 0.00935 UQ	< 0.0206	< 0.00943	< 0.0196	< 0.00952	< 0.00980	< 0.0971	< 0.00943	< 0.00990	0.0108			
Aroclor 1232	ug/L		0.034	< 0.00935 UQ	< 0.0206	< 0.00943	< 0.0196	< 0.00952	< 0.00980	< 0.0971	< 0.00943	< 0.0335	0.0132			
Aroclor 1242	ug/L		0.034	< 0.00935 UQ	< 0.0206	< 0.00943	< 0.0196	< 0.00952	< 0.00980	< 0.0971	< 0.00943	< 0.0248	0.0116			
Aroclor 1248	ug/L		0.034	0.0166 UQ	< 0.0206	< 0.00943	< 0.0196	< 0.00952	< 0.00980	< 0.0971	< 0.00943	< 0.0198	0.0132			
Aroclor 1254	ug/L		0.034	< 0.00935 UQ	< 0.0206	< 0.00943	< 0.0196	< 0.00952	< 0.00980	< 0.0971	< 0.00943	< 0.0198	0.0119			
Aroclor 1260	ug/L		0.034	< 0.00935 UQ	< 0.0206	< 0.00943	< 0.0196	< 0.00952	< 0.00980	< 0.0971	< 0.00943	< 0.0209	0.0123			
Aroclor 1262	ug/L			< 0.00935 UQ	< 0.0206	< 0.00943	< 0.0196	< 0.00952	< 0.00980	< 0.0971	< 0.00943	< 0.0211	0.0116			
Aroclor 1268	ug/L			< 0.00935 UQ	< 0.0206	< 0.00943	< 0.0196	< 0.00952	< 0.00980	< 0.0971	< 0.00943	< 0.0209	0.0116			
Total PCBs	ug/L		2	0.000064	0.0166	< 0.0206	< 0.00943	< 0.0196	< 0.00980	< 0.0971	< 0.0138		0.0148			
Pesticides																
4,4-DDE	ug/L		0.01	0.00022	< 0.00467 UQ	< 0.00515	< 0.00476	< 0.00490	< 0.00521	< 0.0297	< 0.0100	< 0.00481	< 0.00971	0.0044		
4,4-DDT	ug/L		1.1	0.00022	< 0.0280 UQ	< 0.0309	< 0.0286	< 0.0294	< 0.0312	< 0.0297	< 0.0300	< 0.0288	< 0.0291	0.0148		
Aldrin	ug/L		3	0.00005	< 0.0280 UQ	< 0.0309	< 0.0286	< 0.0294	< 0.0312	< 0.0297	< 0.0300	< 0.0288	< 0.0291	0.0148		
alpha-Chlordane	ug/L			0.00081	< 0.0280 UQ	< 0.0309	< 0.0286	< 0.0294	< 0.0312	< 0.0297	< 0.0300	< 0.0288	< 0.0291	0.0148		
Chlordane, Technical	ug/L		2.4	0.00081	< 0.346 UQ	< 0.381	< 0.352	< 0.363	< 0.385	< 0.366	< 0.370	< 0.356	< 0.359	0.1821		
Dieletria	ug/L		0.24	0.000054	< 0.0187 UQ	< 0.0206	< 0.0190	< 0.0196	< 0.0208	< 0.0198	< 0.0200	< 0.0192	< 0.0194	0.0098		
gamma-Chlordane	ug/L		2.4	0.00081	< 0.0280 UQ	< 0.0309	< 0.0286	< 0.0294	< 0.0312	< 0.0297	< 0.0300	< 0.0288	< 0.0291	0.0148		
Hexachlorobenzene	ug/L		1	0.00029	< 0.0187 UQ	< 0.0206	< 0.0190	< 0.0196	< 0.0208	< 0.0198	< 0.0200	< 0.0192	< 0.0583	0.0120		
Polycyclic Aromatic Hydrocarbons																
1-Methylnaphthalene	ug/L				< 0.0935	< 0.0825	< 0.0762	< 0.0762	< 0.0808	< 0.0777	< 0.0777	< 0.085	0.079			
2-Methylnaphthalene	ug/L				< 0.0935	< 0.0825	< 0.0762	< 0.0762	< 0.0808	< 0.0777	< 0.0777	< 0.085	0.079			
Acenaphthene	ug/L	95	99	0.0467	< 0.0412	< 0.0381	< 0.0381	< 0.0381	< 0.0404	< 0.0388	< 0.0388	< 0.0404	< 0.0388	0.03		
Acenaphthylene	ug/L		0.2	< 0.0467	< 0.0412	< 0.0381	< 0.0381	< 0.0381	< 0.0404	< 0.0388	< 0.0388	< 0.0404	< 0.0388	0.039		
Anthracene	ug/L	2900	0.2	0.0467	< 0.0412	< 0.0381	< 0.0381	< 0.0381	< 0.0404	< 0.0388	< 0.0388</					

Table 2
Electrocoagulation System Pilot Study Analytical Results
Storm Water Source Control Measure Design Update
Storm Water Source Control Measures
Vigor Industrial, LLC

Outfall				Date	OUTFALL Q - Post EC								EC System	
				5/2/2013	1/7/2014	2/19/2014	3/28/2014	4/23/2014	6/12/2014	7/23/2014	Average	Reduction of Average Concentration	Removal Efficiency	
Sample Type				PS	DG1/NPDES	PS	PS	PS	DG1/NPDES	DG1/NPDES	SW #3 Post-EC			
Sample ID	EC FILTERED_050213	OUTFALL Q-POST EC 1/7/2014	OUTFALL Q-POST EC 2/19/2014	OUTFALL Q-POST EC 03282014	OUTFALL Q-POST EC 04232014	OUTFALL Q-POST EC 06/12/2014	OUTFALL Q-POST EC 07/23/2014	OUTFALL Q-POST EC 08/03/2014	OUTFALL Q-POST EC 08/20/2014	OUTFALL Q-POST EC 08/27/2014	OUTFALL Q-POST EC 09/03/2014			
Analyte	Unit	NPDES Benchmark	NPDES Reference Concentration	JSCS SLV										
Metals														
Aluminum	ug/L	750		200	729	310	237	553	230	56.7	89.8	315	239	43%
Arsenic	ug/L		0.045	0.184	0.195	< 1.00	0.204	0.327	< 1.00			0.318	1.227	79%
Cadmium	ug/L		0.094	0.056 J	< 0.400	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.400	0.071	0.510	88%
Chromium	ug/L		100	< 2.00	1.28	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.64	4.80	88%
Copper	ug/L	20	2.7	10.2	13.1	1.81	4.07	7.23	3.39	2.53 J	2.53 J	6.0	112.2	95%
Iron	ug/L	1000		262	1810	< 50.0	99.8	433	83.3	202	416	3528	89%	
Lead	ug/L	40	0.54	< 1.00	0.322	< 0.200	< 0.200	< 0.200	< 0.200	0.211	0.20	11.21	98%	
Mercury	ug/L		0.77	< 0.050	< 0.050	< 0.050	< 0.05	< 0.05	< 0.05		0.03	0.01	32%	
Nickel	ug/L		16	7.09	3.38	< 1.00	< 1.00	< 1.00	< 1.00	0.933	1.91	5.33	74%	
Selenium	ug/L		5	< 2.00	< 0.500	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	0.54	0.09	14%	
Zinc	ug/L	120	36	58.6	150	32	22.9	115	17.1	31.3	61.0	199.2	97%	
Tributyltin	ug/L		0.072	< 0.050	< 0.0050	< 0.0050	< 0.005	0.33	0.017		0.06	0.01	19%	
PCBs														
Aroclor 1016	ug/L		0.96	< 0.0109	< 0.00980	< 0.00980	< 0.0100	< 0.0102	< 0.196	< 0.00962	0.0183	-0.0069	-60%	
Aroclor 1221	ug/L		0.034	< 0.0109	< 0.00980	< 0.00980	< 0.0100	< 0.0102	< 0.196	< 0.00962	0.0183	-0.0075	-69%	
Aroclor 1232	ug/L		0.034	< 0.0109	< 0.00980	< 0.00980	< 0.0100	< 0.0102	< 0.196	< 0.0240	0.0193	-0.0061	-46%	
Aroclor 1242	ug/L		0.034	< 0.0109	< 0.00980	< 0.00980	< 0.0100	< 0.0102	< 0.196	< 0.0192	0.0190	-0.0073	-63%	
Aroclor 1248	ug/L		0.034	< 0.0109	< 0.00980	< 0.00980	< 0.0100	< 0.0102	< 0.196	< 0.0192	0.0190	-0.0058	-44%	
Aroclor 1254	ug/L		0.034	< 0.0109	< 0.00980	< 0.00980	< 0.0100	< 0.0102	< 0.196	< 0.0192	0.0190	-0.0071	-60%	
Aroclor 1260	ug/L		0.034	< 0.0109	< 0.00980	< 0.00980	< 0.0100	< 0.0102	< 0.196	< 0.0192	0.0183	-0.0060	-49%	
Aroclor 1262	ug/L			< 0.0109	< 0.00980	< 0.00980	< 0.0100	< 0.0102	< 0.196	< 0.0192	0.0206	-0.0090	-78%	
Aroclor 1268	ug/L				< 0.0109	< 0.00980	< 0.00980	< 0.0100	< 0.0102	< 0.196	< 0.0192	0.0206	-0.0090	-78%
Total PCBs	ug/L	2	0.0000064	< 0.0109	< 0.00980	< 0.00980	< 0.0100	< 0.0102	< 0.196		0.0206	-0.0058	-39%	
Pesticides														
4,4-DDE	ug/L	0.01	0.000022		< 0.00467	< 0.00495	< 0.00481	< 0.00505	< 0.00490	< 0.00495	0.0024	0.0019	44%	
4,4-DDT	ug/L	1.1	0.000022	< 0.0319	< 0.0280	< 0.0297	< 0.0288	< 0.0303	< 0.0294	< 0.0297	0.0148	-0.0001	-1%	
Aldrin	ug/L	3	0.00005	< 0.0319	< 0.0280	< 0.0297	< 0.0288	< 0.0303	< 0.0294	< 0.0297	0.0148	-0.0001	-1%	
alpha-Chlordane	ug/L		0.000081	< 0.0319	< 0.0280	< 0.0297	< 0.0288	< 0.0303	< 0.0294	< 0.0297	0.0148	-0.0001	-1%	
Chlordane, Technical	ug/L	2.4	0.000081	< 0.394	< 0.346	< 0.366	< 0.356	< 0.374	< 0.363	< 0.366	0.1832	-0.0011	-1%	
Diechlor	ug/L	0.24	0.000054	< 0.0213	< 0.0187	< 0.0198	< 0.0192	< 0.0202	< 0.0196	< 0.0198	0.0099	-0.0001	-1%	
gamma-Chlordane	ug/L	2.4	0.000081	< 0.0319	< 0.0280	< 0.0297	< 0.0288	< 0.0303	< 0.0294	< 0.0297	0.0148	-0.0001	-1%	
Hexachlorobenzene	ug/L	1	0.000029	< 0.0213	< 0.0187	< 0.0198	< 0.0192	< 0.0202	< 0.0196	< 0.0198	0.0099	0.0021	18%	
Polycyclic Aromatic Hydrocarbons														
1-Methylnaphthalene	ug/L			< 0.0860	< 0.392	< 0.0769	< 0.200	< 0.0769	< 0.190		0.070	0.009	11%	
2-Methylnaphthalene	ug/L			< 0.0860	< 0.392	< 0.0769	< 0.200	< 0.0769	< 0.190		0.070	0.009	11%	
Acenaphthene	ug/L	95	99	< 0.0430	< 0.196	< 0.0385	< 0.0100	< 0.0385	< 0.0952	< 0.481	0.064	-0.001	-2%	
Acenaphthylene	ug/L		0.2	< 0.0430	< 0.196	< 0.0385	< 0.0100	< 0.0385	< 0.0952		0.035	0.004	11%	
Anthracene	ug/L	2900	0.2	< 0.0430	< 0.196	< 0.0385	< 0.0100	< 0.0385	< 0.0952	< 0.481	0.064	-0.001	-2%	
Benzo(a)anthracene	ug/L	1	0.0018	< 0.0430	< 0.196	< 0.0385	< 0.0100	< 0.0385	< 0.0952	< 0.481	0.064	0.010	12%	
Benzo(a)pyrene	ug/L	1	0.0018	< 0.0645	< 0.294	< 0.0577	< 0.0150	< 0.0577	< 0.143	< 0.481	0.079	0.040	33%	
Benzo(b)fluoranthene	ug/L	1	0.0018	< 0.0645	< 0.294	< 0.0577	< 0.0150	< 0.0577	< 0.143	< 0.481	0.079	0.036	31%	
Benzo(g,h,i)perylene	ug/L		0.2	< 0.0430	< 0.196	< 0.0385	< 0.0100	< 0.0385	< 0.0952	< 0.481	0.035	0.033	48%	
Benzo(k)fluoranthene	ug/L	1	0.0018	< 0.0645	< 0.294	< 0.0577	< 0.0150	< 0.0577	< 0.143	< 0.481	0.079			

Table 3
Grattix Box Downspout Treatment Pilot Study Analytical Results
Storm Water Source Control Measure Design Update
Storm Water Source Control Measures
Vigor Industrial, LLC

Analyte	Unit	Influent 9/24/2014	Influent 10/15/2014	Influent 11/21/2014	Influent 12/9/2014	Influent 1/23/2015	Influent 2/5/2015	Influent 3/23/2015	Influent Average ¹	Effluent 9/24/2014	Effluent 10/15/2014	Effluent 11/21/2014	Effluent 12/9/2014	Effluent 1/23/2015	Effluent 2/5/2015	Effluent 3/23/2015	Effluent Average ¹	Reduction of Average Concentration ²	Removal Efficiency ³
Aluminum	mg/L	< 0.0250	0.151	0.143	< 0.025	0.0836	0.0598	< 0.025	0.0732	0.398	0.287	0.129	0.0791	1.47	0.229	0.169	0.3944	-0.3212	-438.9%
Cadmium	mg/L	0.000344	0.0001	0.000189	0.000067	0.000111	0.000167	< 0.00004	0.0001	< 0.00004	< 0.00004	< 0.00004	0.000067	< 0.00004	< 0.00004	0.0000	0.0001	69.8%	
Chromium	mg/L	0.0715	0.0111	0.00667	0.00172	0.00201	0.00119	0.00118	0.0136	0.0494	0.003	0.00127	0.00146	0.00276	0.000878	0.00107	0.0085	0.0051	37.3%
Copper	mg/L	0.0277	0.043	0.0298	0.00542	0.0251	0.0166	0.00239	0.0214	0.00502	0.0027	0.00246	0.00116	0.00677	0.00721	0.00189	0.0039	0.0175	81.9%
Iron	mg/L	0.114	0.409	0.35	0.073	0.182	0.172	0.0534	0.1933	0.523	0.332	0.144	0.131	2.27	0.281	0.192	0.5533	-0.3599	-186.2%
Lead	mg/L	0.00177	0.0118	0.0078	0.00756	0.00221	0.00249	0.000567	0.0049	0.000256	0.0005	0.0002	< 0.0001	0.000811	0.000578	< 0.0001	0.0004	0.0045	92.6%
Nickel	mg/L	0.00106	0.00112	0.00103	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0007	0.000789	< 0.0005	< 0.0005	0.0006333	0.00162	0.000822	< 0.0005	0.0008	0.0000	-3.0%
Zinc	mg/L	5.22	1.53	2.84	2.17	3.59	4.73	1.74	3.1171	0.00724	0.00626	0.00782	0.0206	0.0735	0.16	0.0569	0.0475	3.0697	98.5%

Notes:

mg/L = milligrams per liter

< = Compound not detected. Reportable detection limit shown.

% = percent reduction

¹ = Values are representative of arithmetic averages of each sample with method detection limits assumed as concentrations of compounds not detected.

¹ = Reduction of average concentration is the arithmetic difference between the average influent and average effluent concentrations.

² = Removal efficiency is representative of the percent reduction of each constituent between average influent and average effluent values.

Table 4
Estimated Source Control Measure Technology Effectiveness
Storm Water Source Control Measure Design Update
Storm Water Source Control Measure
Vigor Industrial, LLC

Source Control Measure	Arsenic	Cadmium	Copper	Lead	Zinc	Tributyltin	BEHP	Total PAHs
South Bioretention Pond SCM ¹	30%	5% ²	90%	90%	95%	78% ³	78% ³	78% ³
EC System SCM	83%	85%	95%	98%	97%	29%	60%	96%
Individual roof drain Grattix box ¹	30%	70%	82%	93%	98%	78% ³	78% ³	78% ³

Notes:

- Indicates performance data from high concentration and bioretention pond specific study (Davis et al 2003)
- Indicates performance data from Grattix Box pilot study
- Indicates performance data from electrocoagulation pilot study

% = percent reduction from influent concentration

¹ = Performance data assumed to be equivalent to generic bioretention system from the International Stormwater BMP Database Pollutant Category Summary Statiscal Addendum July 2012 where pilot study or performance data was unavailable

² = Performance conclusions are limited due to large number of non-detects in study data sets

³ = Removal efficiency assumed to be equivalent to total suspended solids removal performance

Table 5
Estimated SCM Annual Mass Removal
Storm Water Source Control Measure Design Update
Storm Water Source Control Measures
Vigor Industrial, LLC

Source Control Measure			South Bioretention Pond SCM	EC System SCM	Low Impact Development Treatment Facilities	Individual Roof Drain Grattix Box Pilot Test	Parking Lot
Area	(acres)	35.0	17.4	1.6	1.8		6.6
Runoff Volume	(gal)	32418268	16070199	1500503	1685750		6122422
Arsenic	Combined Influent Concentration	(ug/L)	1.19	1.14	1.66	0.45	1.27
	Influent Mass	(lbs)	0.023	0.011	0.001	0.000	0.005
	Estimated Treatment Efficiency	%	30%	83%	30%	30%	0%
	Estimated Effluent Concentration	(ug/L)	0.83	0.19	1.15	0.31	1.27
	Estimated Effluent Mass	(lbs)	0.016	0.002	0.001	0.000	0.005
	Estimated Mass Removal	(lbs)	0.007	0.009	0.000	0.000	0.000
Cadmium	Combined Influent Concentration	(ug/L)	0.40	0.63	0.21	0.40	0.21
	Influent Mass	(lbs)	0.008	0.006	0.0002	0.0004	0.001
	Estimated Treatment Efficiency	%	5%	85%	5%	70%	0%
	Estimated Effluent Concentration	(ug/L)	0.38	0.09	0.20	0.12	0.21
	Estimated Effluent Mass	(lbs)	0.007	0.001	0.0002	0.0001	0.0008
	Estimated Mass Removal	(lbs)	0.000	0.005	0.0000	0.0003	0.0000
Copper	Combined Influent Concentration	(ug/L)	136	284	27	207	19
	Influent Mass	(lbs)	2.572	2.655	0.024	0.203	0.067
	Estimated Treatment Efficiency	%	90%	95%	55%	82%	0%
	Estimated Effluent Concentration	(ug/L)	14	14	12	37	19
	Estimated Effluent Mass	(lbs)	0.257	0.133	0.011	0.037	0.067
	Estimated Mass Removal	(lbs)	2.315	2.522	0.013	0.167	0.000
Lead	Combined Influent Concentration	(ug/L)	15	24	265	15	2
	Influent Mass	(lbs)	0.275	0.221	0.232	0.014	0.007
	Estimated Treatment Efficiency	%	90%	98%	49%	93%	0%
	Estimated Effluent Concentration	(ug/L)	1.46	0.47	136.38	1.03	1.87
	Estimated Effluent Mass	(lbs)	0.028	0.004	0.119	0.001	0.007
	Estimated Mass Removal	(lbs)	0.248	0.217	0.113	0.013	0.000
Zinc	Combined Influent Concentration	(ug/L)	1138	773	424	3542	50
	Influent Mass	(lbs)	21.490	7.233	0.370	3478	0.177
	Estimated Treatment Efficiency	%	95%	97%	75%	98%	0%
	Estimated Effluent Concentration	(ug/L)	57	23	105	71	50
	Estimated Effluent Mass	(lbs)	1.074	0.217	0.092	0.070	0.177
	Estimated Mass Removal	(lbs)	20.42	7.02	0.28	3.41	0.00
Tributyltin	Combined Influent Concentration	(ug/L)	0.058	0.059	0.008	0.048	0.006
	Influent Mass	(lbs)	0.001	0.001	0.000	0.000	0.000
	Estimated Treatment Efficiency	%	78%	29%	37%	78%	0%
	Estimated Effluent Concentration	(ug/L)	0.013	0.042	0.005	0.011	0.006
	Estimated Effluent Mass	(lbs)	0.000	0.000	0.000	0.000	0.000
	Estimated Mass Removal	(lbs)	0.001	0.000	0.000	0.000	0.000
BEHP	Combined Influent Concentration	(ug/L)	6.4	6.2	2.2	4.0	1.8
	Influent Mass	(lbs)	0.120	0.058	0.002	0.004	0.006
	Estimated Treatment Efficiency	%	78%	60%	37%	78%	0%
	Estimated Effluent Concentration	(ug/L)	1.4	2.5	1.4	0.9	1.8
	Estimated Effluent Mass	(lbs)	0.027	0.023	0.001	0.001	0.006
	Estimated Mass Removal	(lbs)	0.093	0.035	0.001	0.003	0.000
Total PAHs	Combined Influent Concentration	(ug/L)	0.46	0.44	0.36	0.52	0.05
	Influent Mass	(lbs)	0.009	0.004	0.000	0.001	0.000
	Estimated Treatment Efficiency	%	78%	96%	37%	78%	0%
	Estimated Effluent Concentration	(ug/L)	0.10	0.02	0.23	0.12	0.05
	Estimated Effluent Mass	(lbs)	0.002	0.000	0.000	0.000	0.000
	Estimated Mass Removal	(lbs)	0.007	0.004	0.000	0.000	0.000

Notes

ug/L = micrograms per liter

gal = gallons

lbs = Pounds

% = Percent

SCM = Source Control Measure

Attachment A
Interim NPDES Tier II Source
Control and Treatment Measure
Layout



Notes:

All subsurface features are approximate
Aerial Photo: City of Portland, July 2012

Figure 1
*Interim NPDES Tier II Source Control
and Treatment Measure Layout*
Vigor Industrial, LLC
Portland, Oregon

*Attachment B
Storm water Source Control
measure PHASE 3 – Stormwater
Reconveyance and Bioretention
Pond Design Drawings*

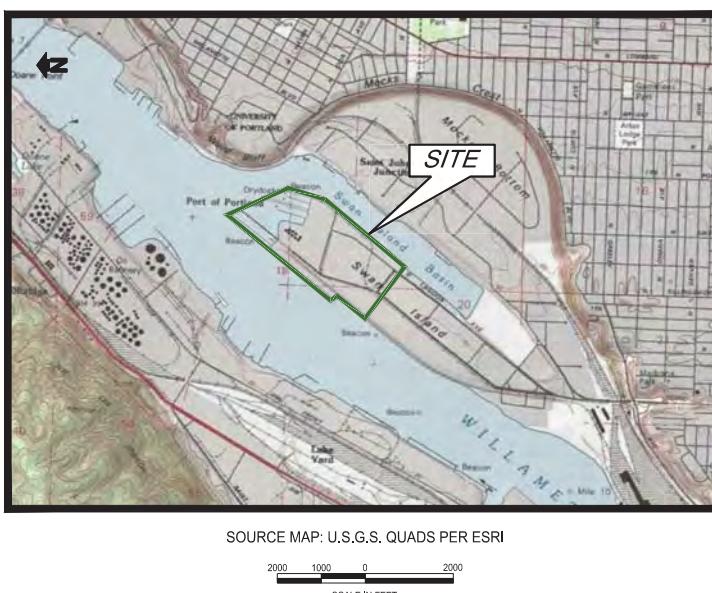
STORMWATER SOURCE CONTROL

PHASE 3 - BIORETENTION FACILITY IMPLEMENTATION

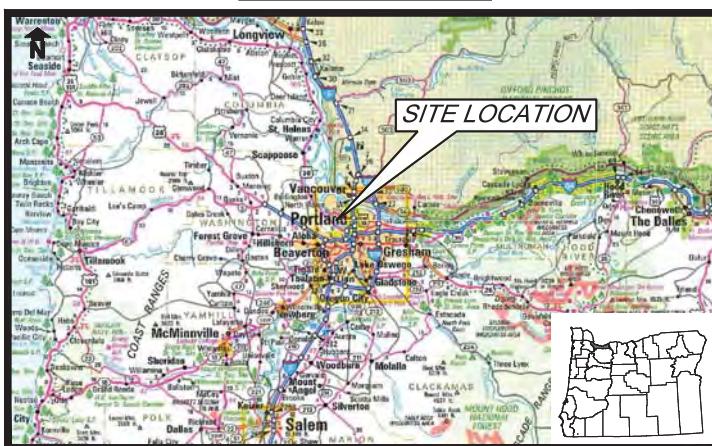
VIGOR INDUSTRIAL LLC

PORTLAND, OREGON

SITE LOCATION MAP



SITE VICINITY MAP



PROJECT LOCATION
5555 N. CHANNEL AVE.
PORTLAND, OREGON 97217

LATITUDE: 45.565
LONGITUDE: -122.721

PROJECT DESCRIPTION
TAX LOTS R61740050, R61740100, R61740200,
LOCATED IN THE SECTIONS 13 AND 18,
TOWNSHIP 1 NORTH, RANGE 1 EAST AND RANGE
1 WEST, WILLAMETTE MERIDIAN, MULTNOMAH
COUNTY, OREGON

ISSUED FOR SWPCP UPDATE
JUNE 2015

PREPARED FOR
VIGOR INDUSTRIAL LLC

PREPARED BY



Environmental Resources Management

Portland, Oregon (503) 488-5282



DRAWING INDEX

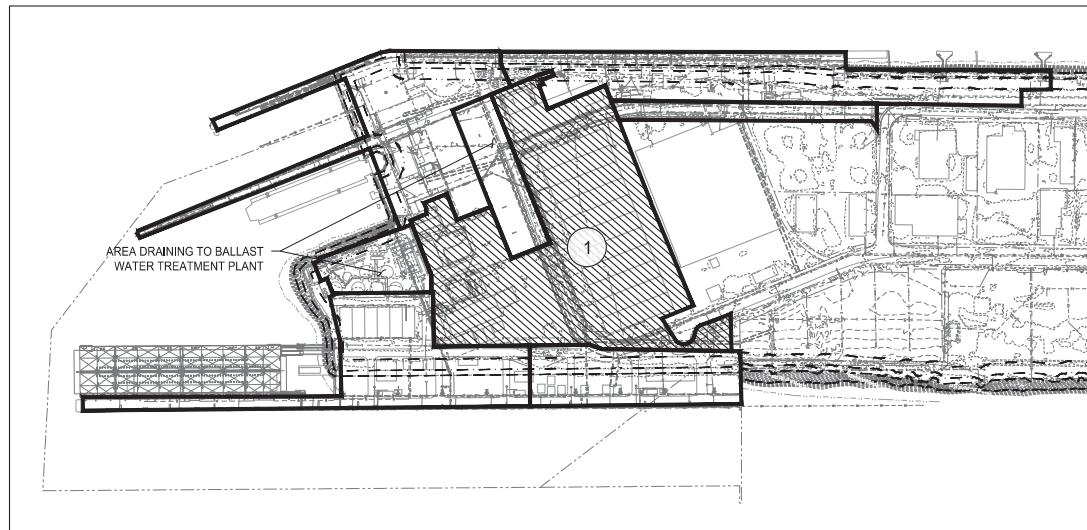
C-01	COVER SHEET
C-02	LEGEND
CIVIL	
C-03	EXISTING CONDITIONS
C-03A	EXISTING CONDITIONS WITH PROPOSED CITY OF PORTLAND EASEMENTS
C-04	PHASE 3 (REF. NOTE 2) - STORMWATER CONVEYANCE PLAN & BIORETENTION FACILITY IMPLEMENTATION
C-04A	PHASE 3 - FORCEMAIN MARSHALLING PLAN
C-05	PHASE 2 - NORTH LAGOON AVENUE BYPASS
C-06	PHASE 3 - BIORETENTION FACILITY GRADING PLANS
C-06A	PHASE 3 - BIORETENTION FACILITY PROFILE
C-06B	PHASE 3 - BIORETENTION FACILITY VEGETATION PLAN, PLANT SCHEDULE, DETAILS AND NOTES
C-07	PHASE 4 - BERTH 303-305 & 313-314 RECONVEYANCE
C-08	PHASE 5 - ELECTROCOAGULATION SOURCE CONTROL MEASURE
G-09	EROSION AND SEDIMENTATION CONTROL PLAN - PHASE 1 - STORMWATER COLLECTION/CONVEYANCE PLAN
C-10	EROSION AND SEDIMENTATION CONTROL PLAN - PHASE 2 - NORTH LAGOON AVENUE BYPASS
C-11	EROSION AND SEDIMENTATION CONTROL PLAN - PHASE 3 - BIORETENTION FACILITY IMPLEMENTATION
C-12	EROSION AND SEDIMENTATION CONTROL PLAN - PHASE 4 - BERTH 303-305 & 313-314 RECONVEYANCE
C-13	EROSION AND SEDIMENTATION CONTROL PLAN - PHASE 5 - ELECTROCOAGULATION SCM
C-14	CONSTRUCTION DETAILS - LIFT STATION PLANS AND SECTIONS
C-15	CONSTRUCTION DETAILS
C-16	CONSTRUCTION DETAILS
C-17	CONSTRUCTION DETAILS
C-18	EROSION AND SEDIMENTATION CONTROL DETAILS AND NOTES
E-19	PROCESS FLOW DIAGRAM - PHASE 1 - STORMWATER COLLECTION/CONVEYANCE PLAN
C-20	PROCESS FLOW DIAGRAM - PHASE 3 - BIORETENTION FACILITY IMPLEMENTATION
C-21	PROCESS FLOW DIAGRAM - PHASE 4 - BERTH 303-305 & 313-314 RECONVEYANCE
C-22	PROCESS FLOW DIAGRAM - PHASE 5 - ELECTROCOAGULATION SCM

INSTRUMENTATION AND CONTROL

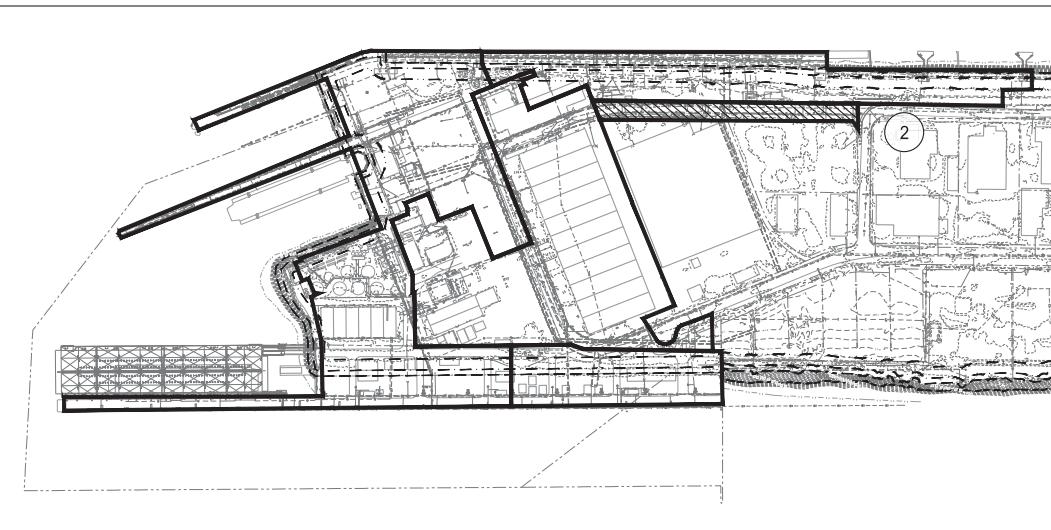
IC-01	PROCESS & INSTRUMENTATION DIAGRAM STANDARD SYMBOL LEGEND
IC-02	PROCESS & INSTRUMENTATION DIAGRAM VAULTS AND LIFT STATIONS (SHEET 1)
IC-03	PROCESS & INSTRUMENTATION DIAGRAM VAULTS AND LIFT STATIONS (SHEET 2)

NOTES:

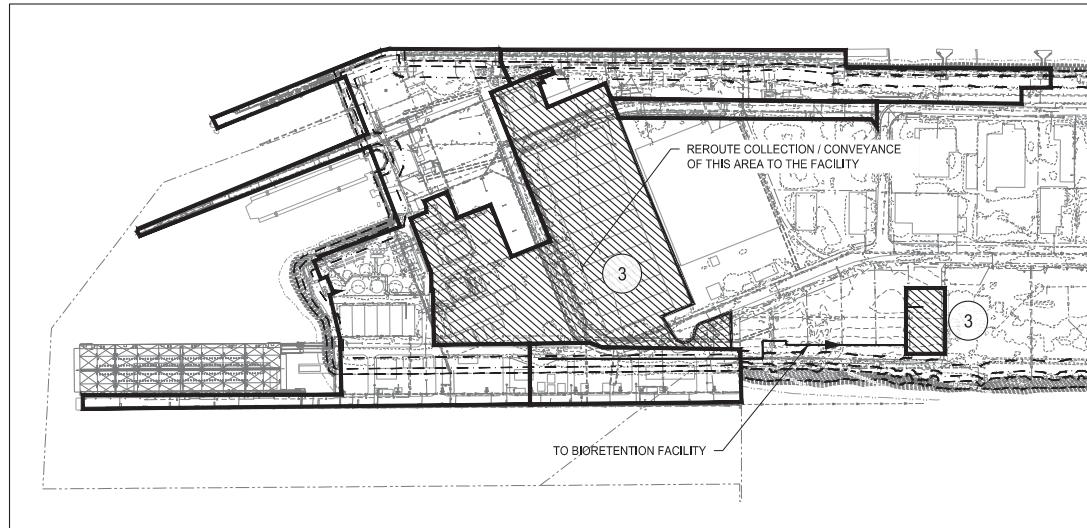
1. GRAY TEXT INDICATES DRAWINGS THAT ARE PART OF THE ENTIRE SOURCE CONTROL DESIGN BUT NOT RELEASED AS PART OF THIS SET.
2. PHASE 1 INCORPORATED INTO PHASE 3.



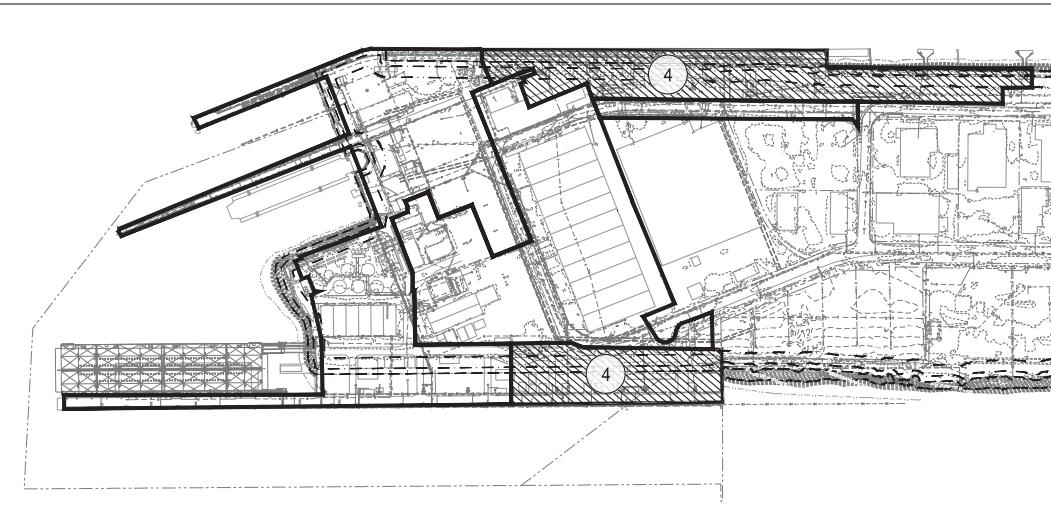
PHASE 1 - INCORPORATED INTO PHASE 3
STORMWATER COLLECTION/CONVEYANCE
(WINTER 2014)



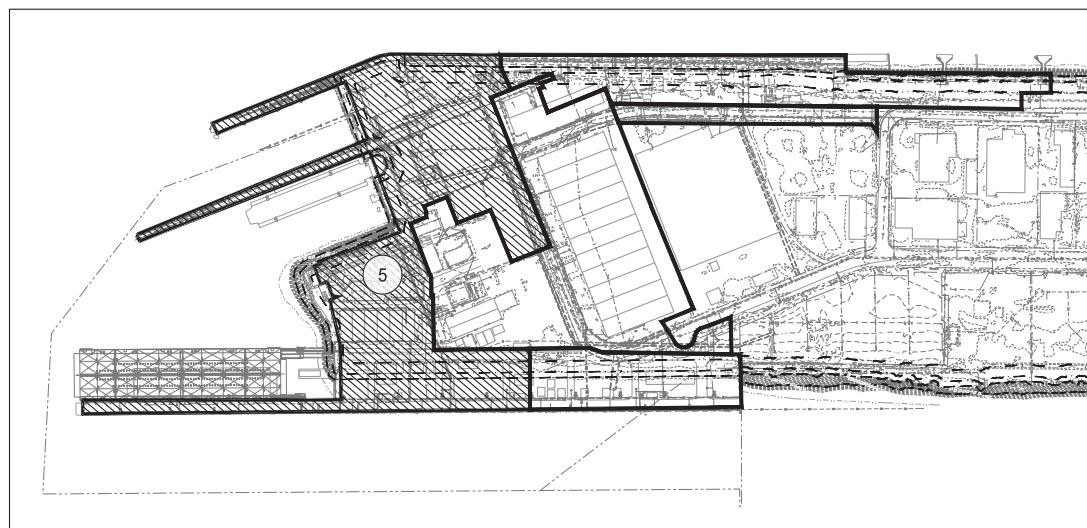
PHASE 2 - ON HOLD PENDING INTERIM MEASURE EVALUATION
NORTH LAGOON AVENUE BYPASS
(SPRING 2015)



PHASE 3
STORMWATER CONVEYANCE & BIORETENTION FACILITY IMPLEMENTATION
(FALL 2015)



PHASE 4
BERTH 303-305 AND 313-314 RECONVEYANCE
(SCHEDULE TO BE DETERMINED)



PHASE 5
ELECTROCOAGULATION SOURCE CONTROL MEASURE
(SCHEDULE TO BE DETERMINED)

LEGEND

EXISTING CONTOUR	FS FS	FILTER SOCK
PROPOSED CONTOUR	SAN SAN	SANITARY SEWER AND MANHOLE
EXISTING STORMWATER FEATURES AND FLOW DIRECTION ARROW	ST ST	STORM SEWER AND MANHOLE
TAX LOTS	W W	WATER LINE AND MANHOLE
PROPERTY BOUNDARY	C C	ELECTRIC LINE
CITY OF PORTLAND UTILITY EASEMENT	UT UT	GAS LINE
INDUSTRIAL OVERLAY ZONE OFFSET	CA CA	UNIDENTIFIED UTILITY
GREENWAY SETBACK	HO HO	COMPRESSED AIR LINE
TOP OF BANK / SEA WALL	O O	NATURAL GAS LINE
ORDINARY HIGH WATER MARK	OX OX	OIL LINE
LIMIT OF DISTURBANCE	DTM DTM	OXYGEN LINE
ON-SITE TRAFFIC FLOW	T T	STEAM LINE
WATER VALVE PIT		TELECOMMUNICATIONS LINE
STREET LIGHT		CATCH BASIN
HYDRANT		PROPOSED FORCEMAIN
		PROPOSED GRAVITY PIPE

REGISTERED PROFESSIONAL ENGINEER 78496PE BYRDAN ANDREW ROBINSON OREGON EXPIRED DECEMBER 31, 2016	Rev. Date Description By Chk	
DRAWN BY PLS	DESIGNED BY AMB	CHECKED BY AMB

Environmental Resources Management
Portland, Oregon (503)-488-5282

VIGOR INDUSTRIAL LLC PHASE 3 CONVEYANCE & BIORETENTION FACILITY PORTLAND OREGON		
LEGEND		
SCALE AS SHOWN	PROJECT NUMBER 0272376	HEET C-02
DATE JUNE 12, 2015	ISSUE SWPC UPDATE	REV.

GENERAL NOTES:

- PLAN LOCATIONS AND DIMENSIONS SHALL BE STRICTLY ADHERED TO UNLESS OTHERWISE DIRECTED BY THE OWNER'S REPRESENTATIVE.
- CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS AND DIMENSIONS PRIOR TO ORDERING AND/OR FABRICATION OF ANY MATERIALS.
- CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR INITIATING, MAINTAINING AND SUPERVISING ALL SAFETY PRECAUTIONS AND PROGRAMS IN CONNECTION WITH THE WORK.
- CONTRACTOR SHALL SUPERVISE AND DIRECT THE WORK. HE/SHE WILL BE SOLELY RESPONSIBLE FOR THE MEANS, METHODS, TECHNIQUES, PROCEDURES AND SEQUENCES, EXCEPT FOR THE OVERALL SEQUENCE OF CONSTRUCTION WHICH WILL BE CONDUCTED IN ACCORDANCE WITH THE SOIL EROSION & SEDIMENT CONTROL PLAN.
- CONTRACTOR SHALL PATCH, REPAIR AND FINISH OR REPLACE ALL SURFACES, EQUIPMENT, OR FEATURES RESTORING SAID SURFACES, EQUIPMENT OR FEATURES DAMAGED DURING THE WORK TO THEIR PRE-WORK OR AS-DESIGNED CONDITION.
- FABRICATION AND INSTALLATION OF ALL MATERIALS, FINISHES, ETC. SHALL BE IN ACCORDANCE WITH MANUFACTURER'S WRITTEN INSTRUCTIONS, UNLESS OTHERWISE SPECIFIED IN THE DESIGN.
- ALL CONSTRUCTION TO BE IN ACCORDANCE WITH LOCAL BUILDING CODES AND THE OREGON DEPARTMENT OF TRANSPORTATION ROAD AND BRIDGE STANDARDS UNLESS OTHERWISE SPECIFIED.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING THE EXACT LOCATION OF UTILITIES, WHETHER SHOWN OR NOT SHOWN ON THE DRAWINGS, AND SHALL BE RESPONSIBLE FOR ALL COSTS INCURRED IN THE REPAIR OF ANY DAMAGE TO SAME RESULTING FROM THE CONTRACTOR'S WORK ASSOCIATED WITH THIS PROJECT. ANY DISCREPANCIES SHOULD BE REPORTED TO THE OWNER'S REPRESENTATIVE IMMEDIATELY.
- THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PROTECT THE EXISTING UTILITIES AND MAINTAIN UNINTERRUPTED SERVICE AND ANY DAMAGE DONE TO THEM DUE TO HIS/HER NEGLIGENCE SHALL BE IMMEDIATELY AND COMPLETELY REPAIRED AT HIS/HER EXPENSE.
- IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO ENSURE THERE IS SUFFICIENT COVER ON ALL PIPING DURING CONSTRUCTION TO PREVENT DAMAGE TO, OR FAILURE OF, PIPES.

- ALL EXCAVATIONS SHALL BE KEPT DRY AT ALL TIMES UNLESS OTHERWISE NOTED.
- ALL DIMENSIONS ARE TO CENTERLINE OF UTILITY UNLESS OTHERWISE NOTED.
- THE CONTRACTOR SHALL OBTAIN THEIR OWN TRAILER AT NO EXTRA COST TO THE OWNER.
- CONTRACTOR WILL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS REQUIRED FOR CONSTRUCTION PRIOR TO INITIATION OF WORK.

- THESE PLANS ARE BASED ON INFORMATION AVAILABLE AT THE TIME THEY WERE PREPARED. ACTUAL CONDITIONS DETERMINED LATER MAY VARY. SOUND ENGINEERING JUDGMENT SHOULD BE EXERCISED DURING CONSTRUCTION TO ASSURE THAT THE DESIGN IS COMPATIBLE WITH THE ACTUAL CONDITIONS.
- REFERENCE TO "OWNER" SHALL MEAN "VIGOR INDUSTRIAL".

TOPOGRAPHIC REFERENCES:

- SURVEY AND DRAWING FILES OF UTILITIES, SITE INFRASTRUCTURE, ETC., COMBINED BY DAVID EVANS & ASSOCIATES, INC., PORTLAND, OREGON, DECEMBER 2013.
- FIELD VERIFIED NOVEMBER 20, 2014 THAT CB 149 IS AN INLET THAT DRAINS TO MANHOLE AS INDICATED IN EXISTING CONDITIONS.
- TOPOGRAPHIC SURVEY OF THE MAIN PARKING LOT CONDUCTED BY DAVID EVANS & ASSOCIATES, INC., PORTLAND, OREGON.
- TOPOGRAPHIC MAPPING OF SURROUNDING AREAS GENERATED FROM USACE COLUMBIA RIVER LIDAR DATA, FLOWN 2010. THE TOPOGRAPHIC SURVEY HORIZONTAL DATUM IS OREGON STATE PLANES, NORTH ZONE, US FOOT, NAD 83 AND THE VERTICAL DATUM IS NAVD 88.
- TOPOGRAPHIC SURVEY OF NORTH LAGOON AVE CONDUCTED BY DAVID EVANS & ASSOCIATES, INC., PORTLAND, OREGON, DECEMBER 2014.

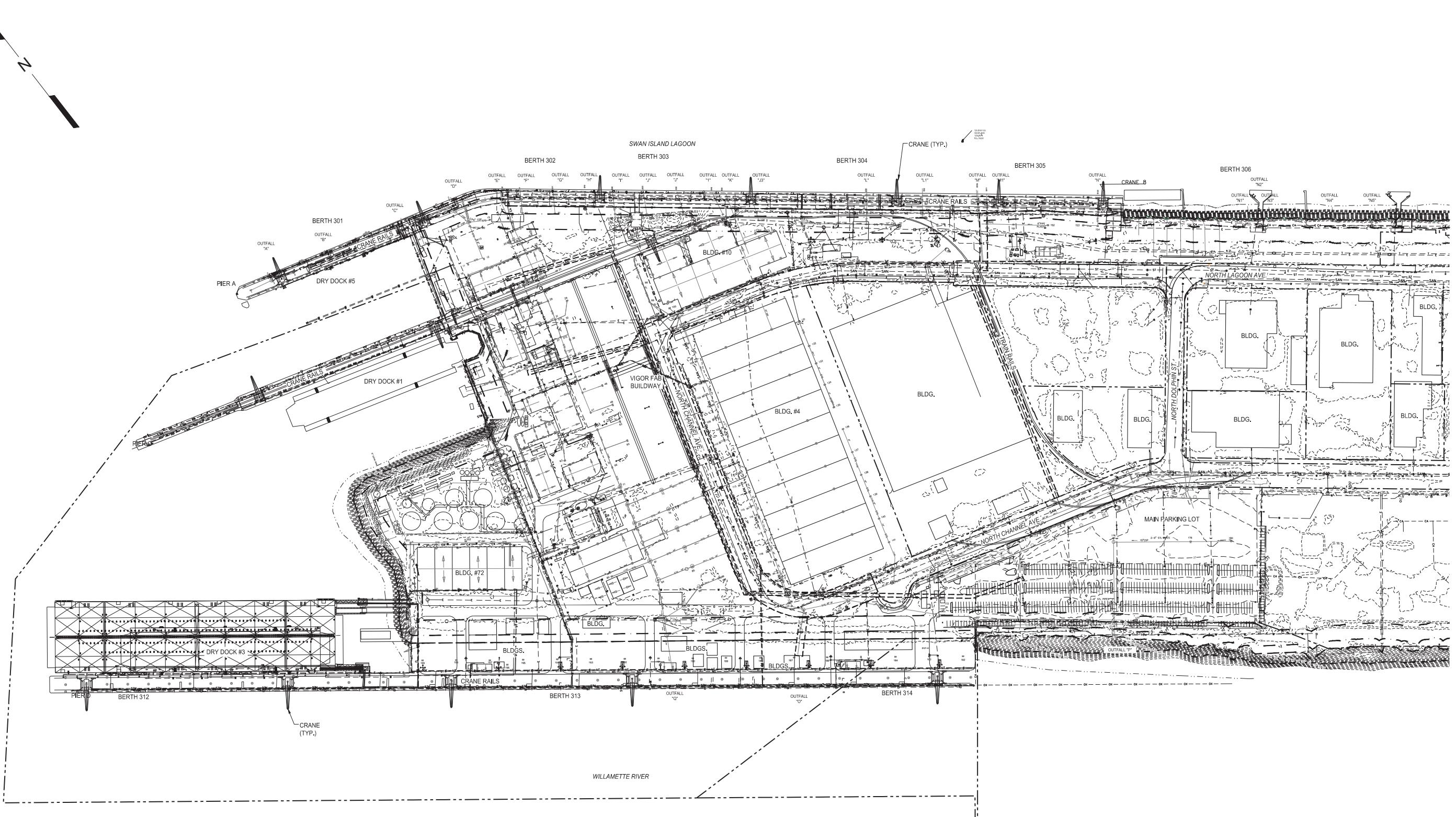
PHASE SPECIFIC NOTE:

- PHASE 2: TO BE DETERMINED WHETHER SCOPE OF WORK INCLUDES CAPTURE AND TREATMENT OF STREET RUNOFF. PROJECT SCOPE MAY BE LIMITED TO DISCONNECTING LATERALS THAT DRAIN OFF-STREET VIGOR INDUSTRIAL PROPERTY.
- PHASE 4: WILL BE DETERMINED IF PROPOSED FORCEMAIN WILL BE BURIED OR SUSPENDED FROM DOCK STRUCTURE. HEAT TRACING WILL BE REQUIRED IF FORCEMAIN WILL BE INSTALLED ABOVE GRADE.

ABBREVIATIONS

AFF	ABOVE FINISHED FLOOR	I.E.	INVERT ELEVATION
BG	BELOW GRADE	LS	LIFT STATION
BLDG.	BUILDING	MAX.	MAXIMUM
BMP	BEST MANAGEMENT PRACTICE	MIN.	MINIMUM
CMP	CORRUGATED METAL PIPE	NOM.	NOMINAL
DEQ	STATE OF OREGON: DEPARTMENT OF ENVIRONMENTAL QUALITY	PVC	POLYVINYL CHLORIDE
DGA	DENSE GRADED AGGREGATE	REF.	REFERENCE
DIA.	DIAMETER	SCH	SCHEDULE
ELEV.	ELEVATION	SCM	SOURCE CONTROL MEASURE
ESCP	EROSION AND SEDIMENTATION CONTROL PLAN	TYP.	TYPICAL
FT.	FEET		

400 200 0 400
SCALE IN FEET

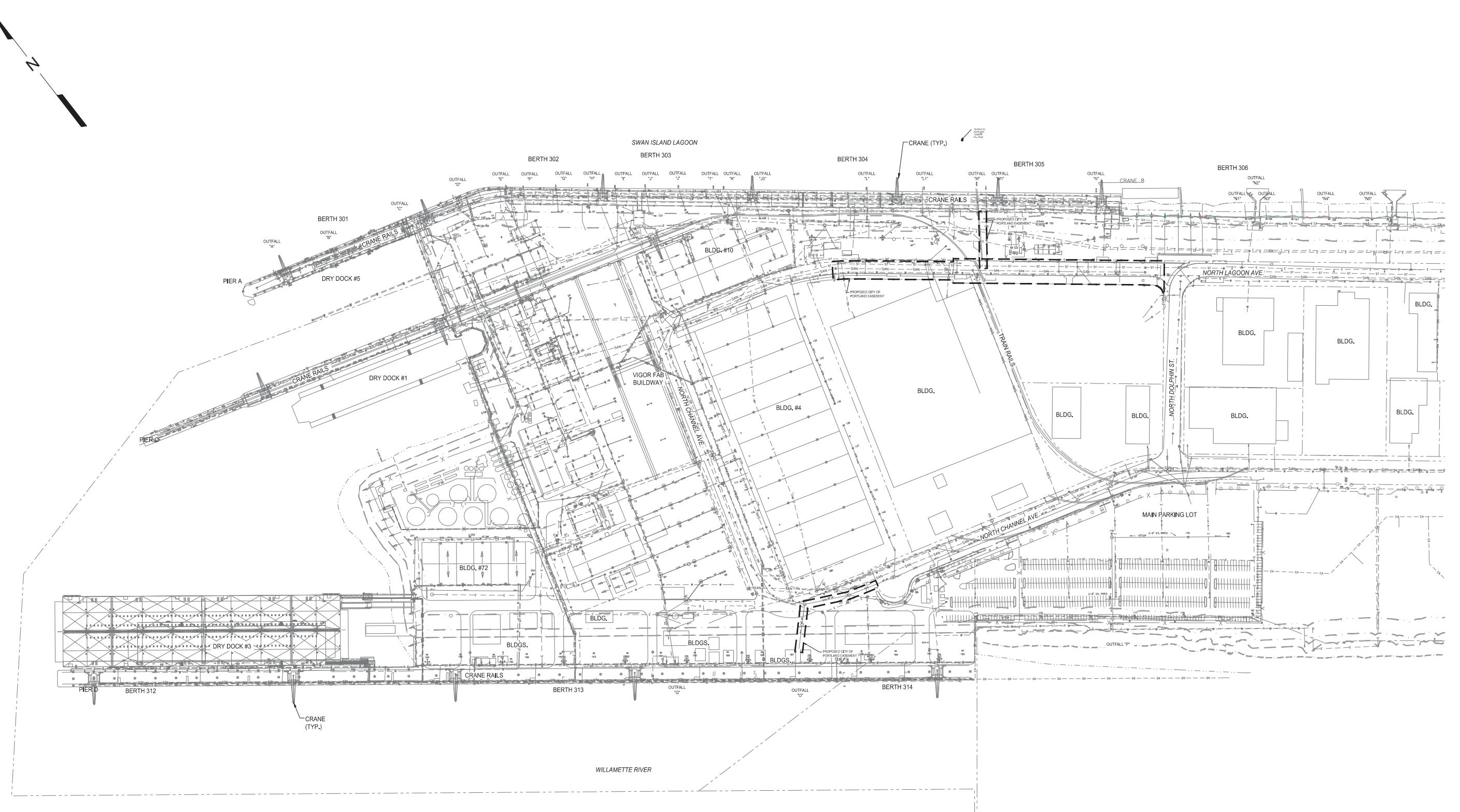


NOTE:

1. EXISTING EASEMENTS SHOWN.

150
75
0
150
SCALE IN FEET

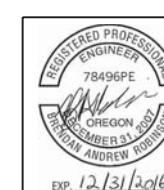
VIGOR INDUSTRIAL LLC PHASE 3 CONVEYANCE & BIORETENTION FACILITY PORTLAND OREGON					
EXISTING CONDITIONS					
<p>REGISTERED PROFESSIONAL ENGINEER 78496PE STATE OF OREGON MEMBER 31-A ANDREW ROBINSON EXPIRED 12/31/2016</p>	Rev.	Date	Description	By	Chk
	DRAWN BY	PLS	DESIGNED BY	AMB	CHECKED BY
Environmental Resources Management Portland, Oregon (503)-488-5282					
SCALE AS SHOWN		PROJECT NUMBER	0272376	SHEET	C-03
DATE JUNE 12, 2015		ISSUE	SWPCP UPDATE	REV.	



NOTE:

1. PROPOSED CITY OF PORTLAND EASEMENTS SHOWN.

150
75
0
150
SCALE IN FEET



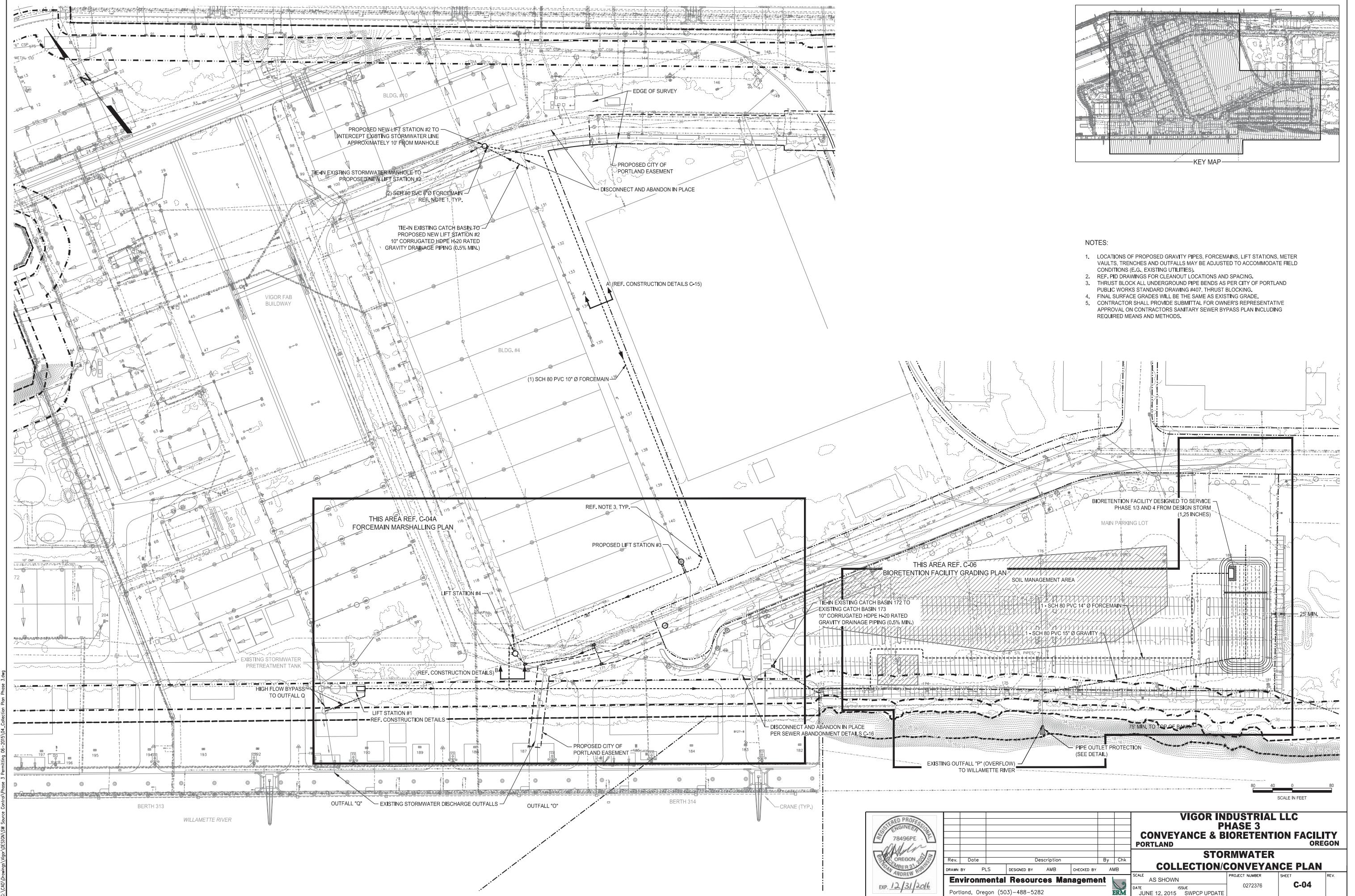
Rev. Date Description By Chk
DRAWN BY PLS DESIGNED BY AMB CHECKED BY AMB
Environmental Resources Management
Portland, Oregon (503)-488-5282

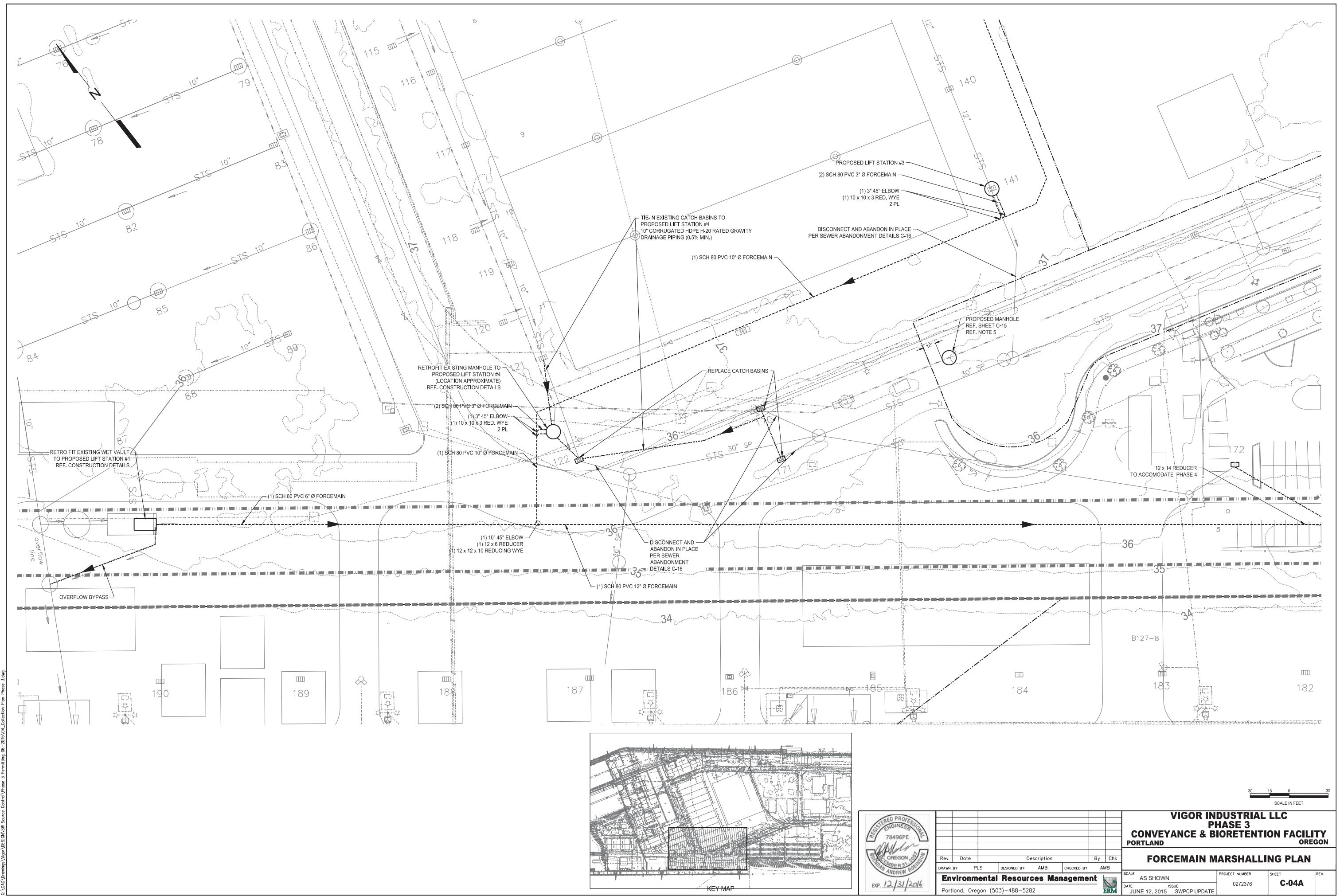
EXISTING CONDITIONS WITH
PROPOSED CITY OF PORTLAND EASEMENTS

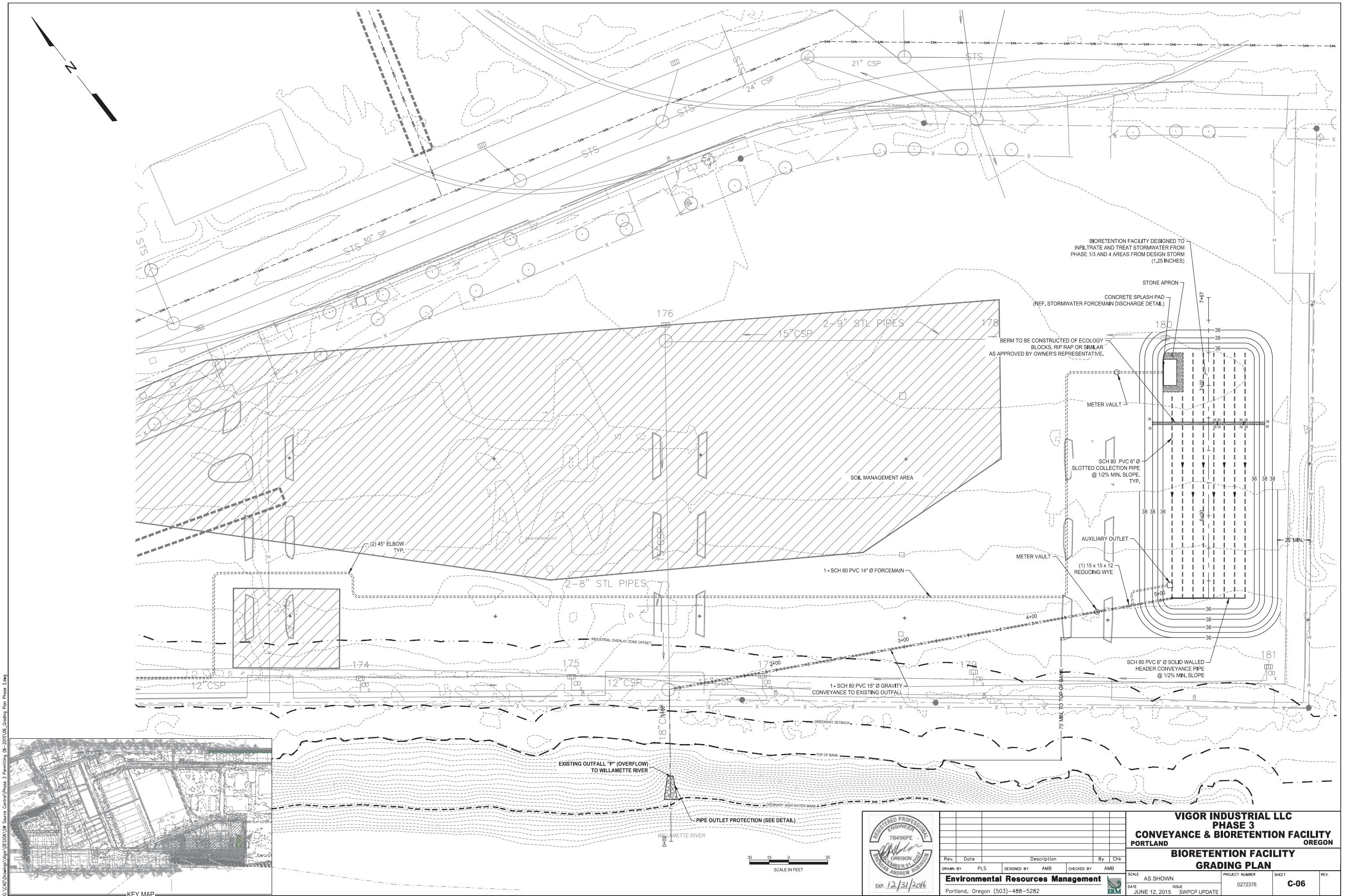
SCALE AS SHOWN PROJECT NUMBER 0272376 SHEET C-03A
DATE JUNE 12, 2015 ISSUE SWPCP UPDATE

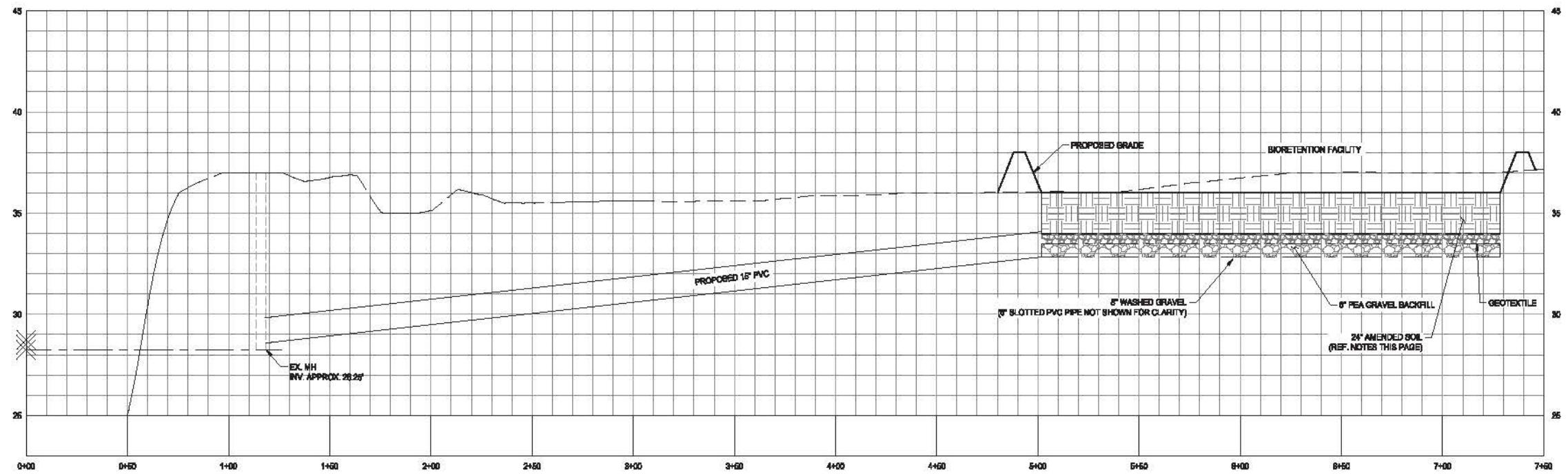
**VIGOR INDUSTRIAL LLC
PHASE 3
CONVEYANCE & BIORETENTION FACILITY
PORTLAND OREGON**

**EXISTING CONDITIONS WITH
PROPOSED CITY OF PORTLAND EASEMENTS**









NOTES:

- ORGANIC MATTER CONTENT (DRY WEIGHT) - 6% OR GREATER (PER ASTM DESIGNATION D 2974).
- PLACE CALCULATED AMOUNT OF COMPOSTED MATERIAL OR APPROVED ORGANIC MATERIAL, AND MIX INTO DEPTH OF SOIL NEEDED TO ACHIEVE 24 INCHES OF SETTLED SOIL AT 5% OR GREATER ORGANIC CONTENT.
- THE EXISTING, STOCKPILED OR IMPORTED SOIL MUST MEET THE FOLLOWING GRADATION REQUIREMENTS:

SIEVE SIZE	PERCENT PASSING (BY WEIGHT)
NO. 4	100
NO. 10	95-100
NO. 40	45-60
NO. 100	10-25
NO. 200	5-10

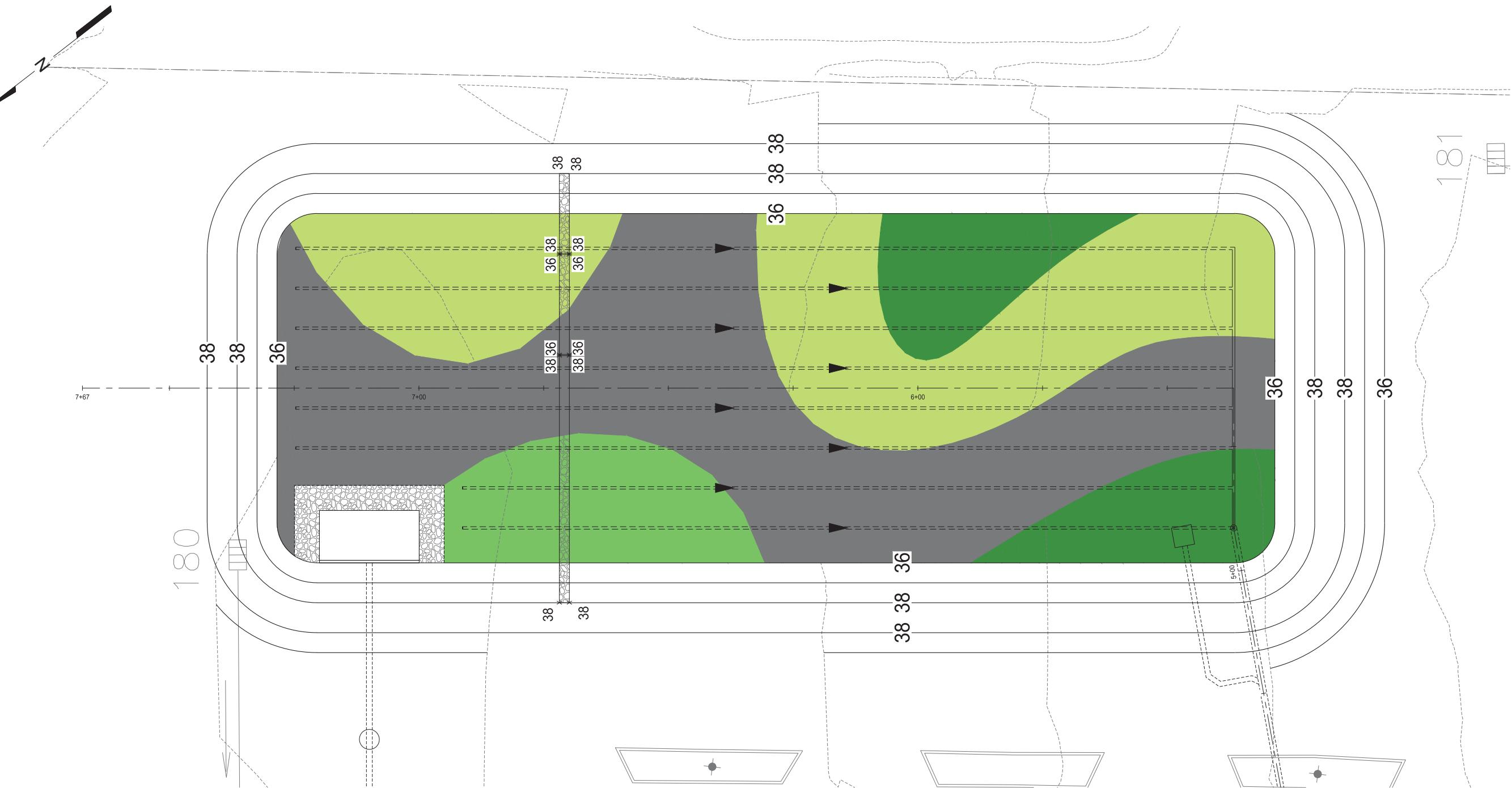
- SAMPLING MUST MEET THE REQUIREMENTS OF AASHTO T2.
- SIEVE ANALYSIS MUST MEET THE REQUIREMENTS OF AASHTO T27 AND AASHTO T11.
- SOCIAL pH - 6.5-8.0
- COMPOST PROPERTIES: THE ORGANIC CONTENT SHALL BE MET USING MEDIUM TYPE COMPOST ACCORDING TO SPECIAL PROVISION 3020. SPECIAL PROVISIONS CAN BE VIEWED USING THE FOLLOWING LINK:
http://www.oregon.gov/ODOT/HWY/SPECs/special_provisions.shtml

1 16 2 20
SCALE IN FEET
10 X VERTICAL EXAGGERATION



Rev.	Date	Description	By	Chk
DRAWN BY	PLS	DESIGNED BY	AMB	CHECKED BY
Environmental Resources Management				
Portland, Oregon (503)-458-5282				

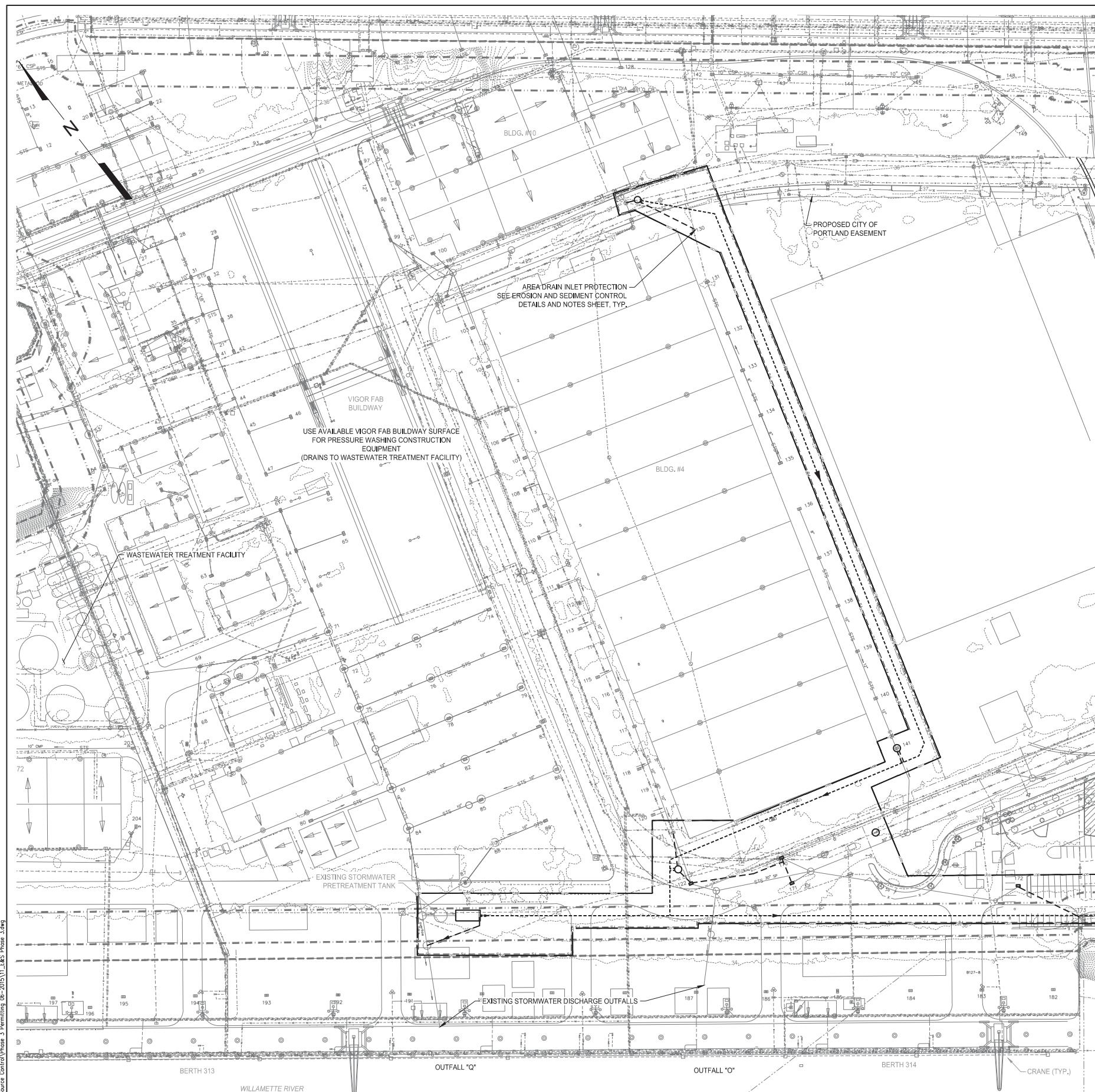
VIGOR INDUSTRIAL LLC PHASE 3 CONVEYANCE & BIORETENTION FACILITY PORTLAND OREGON				
BIORETENTION FACILITY PROFILE				
SCALE	AS SHOWN	PROJECT NUMBER	SHEET	REV.
DATE	JUNE 12, 2015	0272578	C-06A	REV.



PLANTING SCHEDULE	
SYMBOL	SCENT + NAME
Dark Gray	COMMON NAME (S.F.)
<i>Juncus effusus</i>	Common Rush 6,135
Light Green	<i>Carex densa</i> Dense Sedge 4,239
Medium Green	<i>Juncus effusus</i> Spreading Rush 1,331
Lightest Green	<i>Carex testacea</i> Orange Sedge 1,776

10
5
0
10
SCALE IN FEET

VIGOR INDUSTRIAL LLC PHASE 3 CONVEYANCE & BIORETENTION FACILITY PORTLAND OREGON																
BIORETENTION FACILITY VEGETATION PLAN, PLANT SCHEDULE, DETAILS AND NOTES																
 REGISTERED PROFESSIONAL ENGINEER 78496PE STATE OF OREGON BY DANIEL ANDREW ROBINSON EXPIRED DECEMBER 31, 2016		<table border="1"> <tr> <td>Rev.</td> <td>Date</td> <td>Description</td> <td>By</td> <td>Chk</td> </tr> <tr> <td>DRAWN BY</td> <td>PLS</td> <td>DESIGNED BY</td> <td>AMB</td> <td>CHECKED BY</td> <td>AMB</td> </tr> </table> Environmental Resources Management Portland, Oregon (503)-488-5282				Rev.	Date	Description	By	Chk	DRAWN BY	PLS	DESIGNED BY	AMB	CHECKED BY	AMB
Rev.	Date	Description	By	Chk												
DRAWN BY	PLS	DESIGNED BY	AMB	CHECKED BY	AMB											
SCALE	AS SHOWN	PROJECT NUMBER	0272376	HEET	C-06B											
DATE	JUNE 12, 2015	ISSUE	SWPCP UPDATE	REV.												



CAD Drawing View Revision SW Source Control Phase 3 Permitting 06-2015\11_EAS Phase 3.mwg

OWNER
VIGOR INDUSTRIAL LLC
CONTACT: ALAN SPROTT
5555 N. CHANNEL AVE.
PORTLAND, OREGON 97217
PHONE: 503-247-1672

OWNER'S REPRESENTATIVE
BRENDAN ROBINSON
ERM
1001 SW 5TH AVENUE
PORTLAND, OREGON 97204

NARRATIVE DESCRIPTION

EXISTING SITE CONDITIONS
DEVELOPED INDUSTRIAL SHIPYARD, PAVED, NUMEROUS BUILDINGS, SHIPBUILDING EQUIPMENT AND STORMWATER COLLECTION/CONVEYANCE SYSTEM.

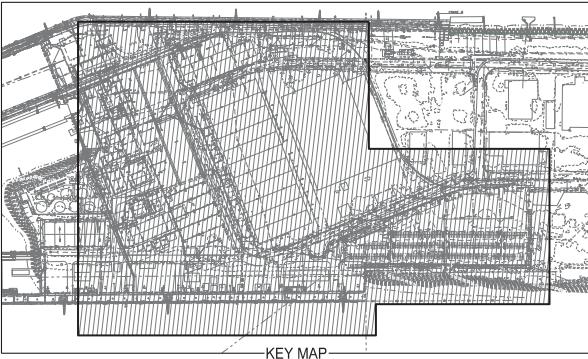
CONSTRUCTION SCOPE OF WORK
PHASE OF MULTIPHASE STORMWATER SOURCE CONTROL PROJECT INVOLVES STORMWATER COLLECTION/CONVEYANCE RETROFIT - PRIMARILY INSTALLATION OF NEW PUMP LIFT STATIONS AND FORCEMAIN CONVEYANCE PIPE.

TOTAL SOIL DISTURBANCE AREA
< 10,000 SF

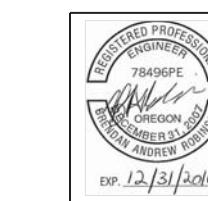
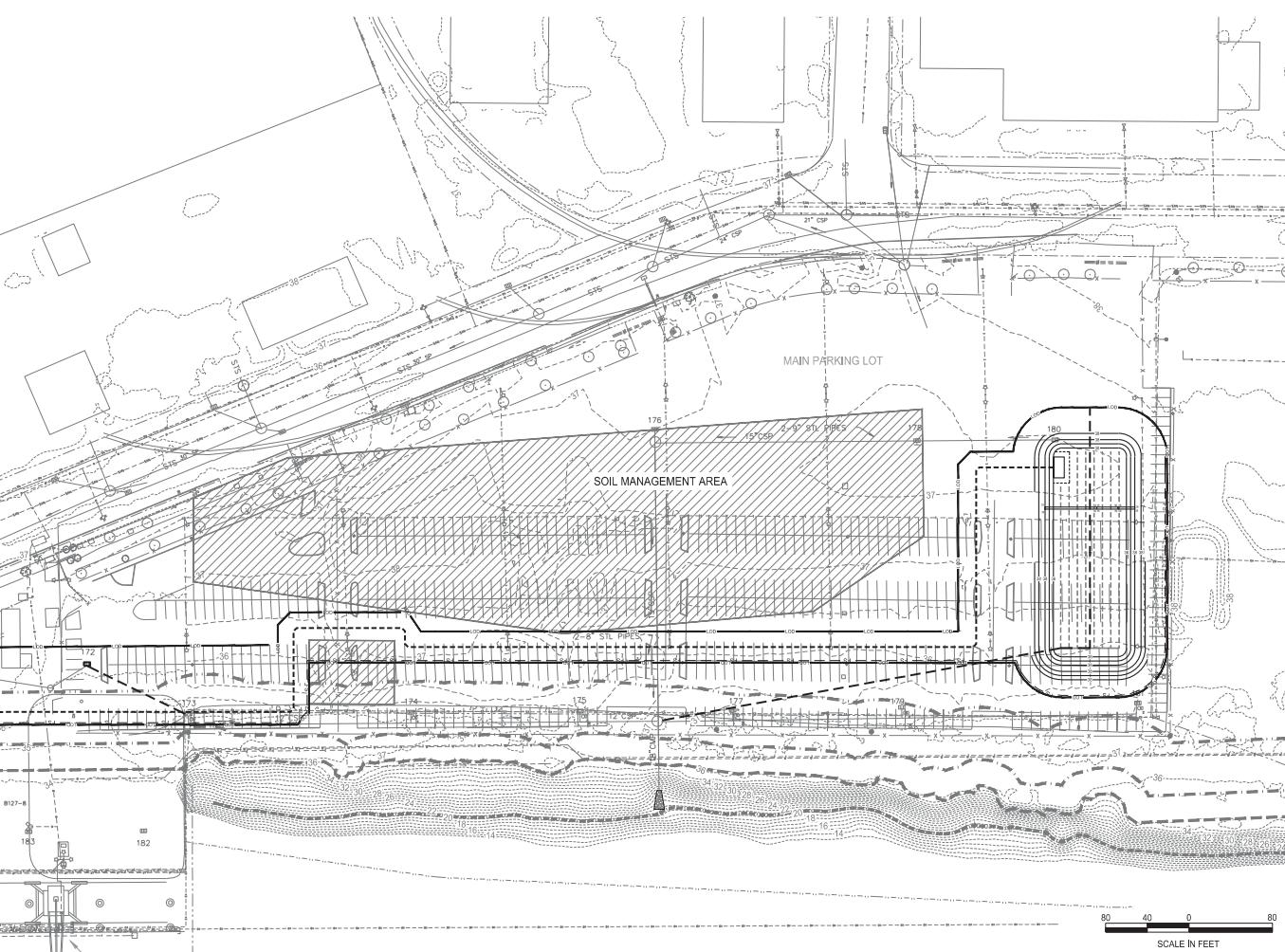
SCHEDULE
SPRING 2015

RECEIVING WATER BODY
WILLAMETTE RIVER

EROSION AND SEDIMENTATION CONTROL INSPECTOR
NAME: BRENDAN ROBINSON, P.E.
CREDENTIAL: ENGINEER OF RECORD
COMPANY: ENVIRONMENTAL RESOURCES MANAGEMENT
PHONE: (503) 488-5011
EMAIL: BRENDAN.ROBINSON@ERM.COM

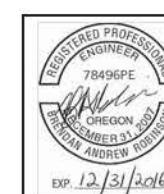
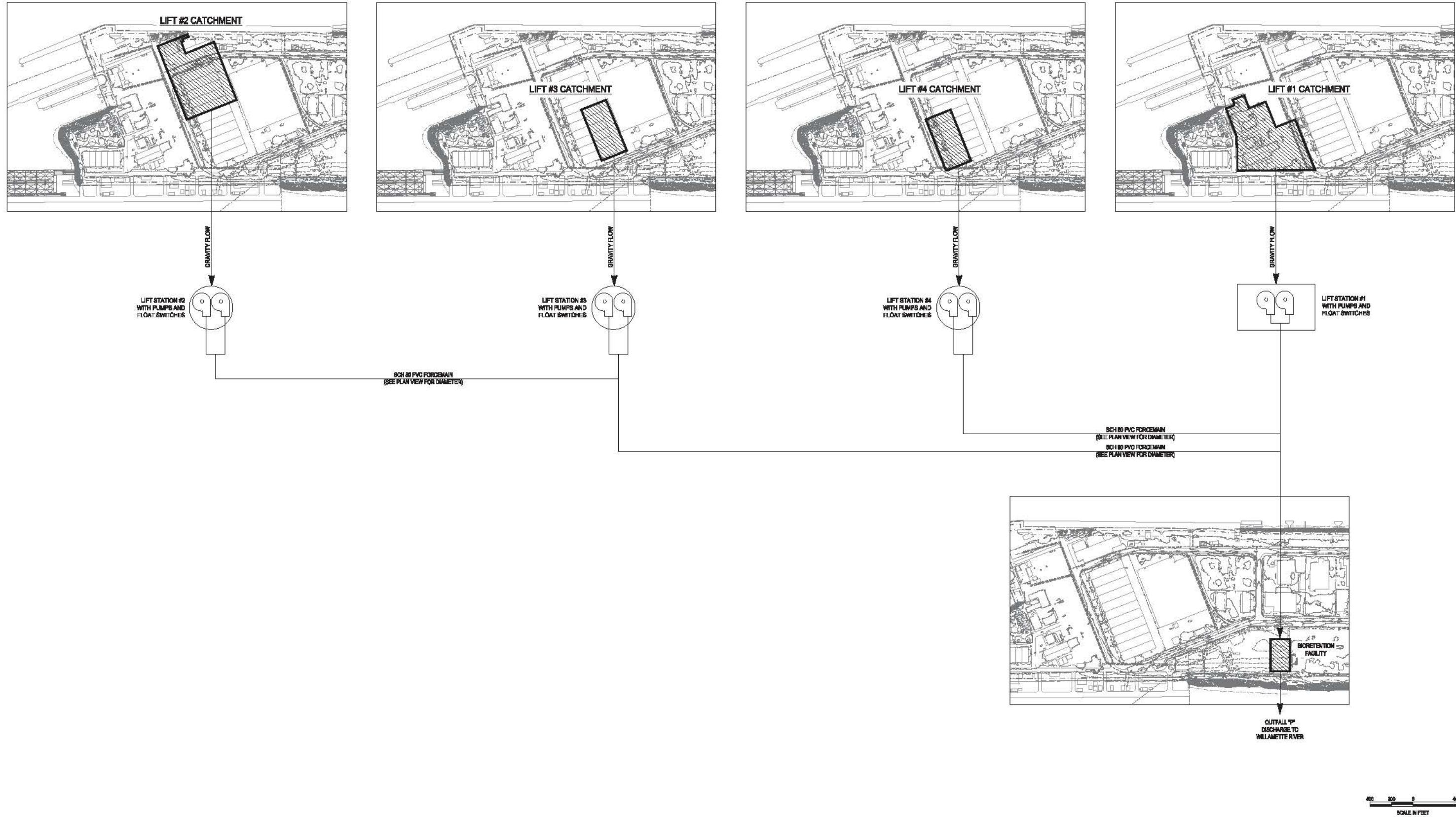


KEY MAP



Rev.	Date	Description	By	Chk
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Environmental Resources Management				
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VIGOR INDUSTRIAL LLC PHASE 3 CONVEYANCE & BIORETENTION FACILITY PORTLAND OREGON				
EROSION AND SEDIMENTATION CONTROL PLAN				
SCALE	AS SHOWN	PROJECT NUMBER	HEET	REV.
JUNE 12, 2015	ISSUE SWPCP UPDATE	0272376	C-11	



Rev.	Date	Description	
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VIGOR INDUSTRIAL LLC
PHASE 3
CONVEYANCE & BIORETENTION FACILITY
PORTLAND OREGON

PROCESS FLOW DIAGRAM
BIORETENTION FACILITY IMPLEMENTATION - PHASE 3

Attachment C
Phase 3 Storm Water Modeling

Attachment C - Stormwater Modeling Output

Scope/Purpose: Model DOT storm for specific Vigor Industrial watersheds and corresponding 90 percent design lift stations to determine design flow rates for 1200Z Tier II corrective action design basis.

Notes:

1. Stormwater model: EPA SWMM.
2. DOT storm: 1.25 inches and NRCS Type IA 24-hour distribution.
3. Basins modeled: Lift Station #1 (8.22 Ac), Lift Station #2 (7.63 Ac), Lift Station #3 (3.00), Lift Station #4 (2.97), Lift Station #5 (1.32), Lift Station #6 (5.34), and Lift Station #7 (7.11) catchment areas.
4. Design flow rates were calculated as the average peak flow during a 1.75 hour period for each lift station catchment area.

SWMM Model Watershed Parameters

Lift #1 Area	Lift #2 Area	Lift #3 Area
Area = 8.222 acres	Area = 7.633 acres	Area = 3.003 acres
Width = 600 ft	Width = 490 ft	Width = 245 ft
% Slope = 0.4	% Slope = 0.5	% Slope = 0.5
% Imperv = 95	% Imperv = 95	% Imperv = 95
N-Imperv = 0.014	N-Imperv = 0.014	N-Imperv = 0.014
N-Perv = 0.1	N-Perv = 0.1	N-Perv = 0.1
Dstore-Imperv = 0.175	Dstore-Imperv = 0.175	Dstore-Imperv = 0.175
Dstore-Perv = 0.175	Dstore-Perv = 0.175	Dstore-Perv = 0.175
%Zero-Imperv = 50	%Zero-Imperv = 50	%Zero-Imperv = 50
Subarea Routing = OUTLET	Subarea Routing = OUTLET	Subarea Routing = OUTLET
Percent Routed = 100	Percent Routed = 100	Percent Routed = 100
Infiltration = GREEN_AMPT	Infiltration = GREEN_AMPT	Infiltration = GREEN_AMPT
Groundwater = NO	Groundwater = NO	Groundwater = NO
LID Controls = 0	LID Controls = 0	LID Controls = 0
Land Uses = 0	Land Uses = 0	Land Uses = 0
Initial Buildup = NONE	Initial Buildup = NONE	Initial Buildup = NONE
Curb Length = 0	Curb Length = 0	Curb Length = 0

SWMM Model Watershed Parameters

Lift #4 Area

Area = 2.965 acres
Width = 245 ft
% Slope = 0.5
% Imperv = 95
N-Imperv = 0.014
N-Perv = 0.1
Dstore-Imperv = 0.175
Dstore-Perv = 0.175
%Zero-Imperv = 50
Subarea Routing = OUTLET
Percent Routed = 100
Infiltration = GREEN_AMPT
Groundwater = NO
LID Controls = 0
Land Uses = 0
Initial Buildup = NONE
Curb Length = 0

Lift #5 Area

Area = 1.315 acres
Width = 100 ft
% Slope = 0.5
% Imperv = 95
N-Imperv = 0.014
N-Perv = 0.1
Dstore-Imperv = 0.175
Dstore-Perv = 0.175
%Zero-Imperv = 50
Subarea Routing = OUTLET
Percent Routed = 100
Infiltration = GREEN_AMPT
Groundwater = NO
LID Controls = 0
Land Uses = 0
Initial Buildup = NONE
Curb Length = 0

Lift #6 Area

Area = 5.337 acres
Width = 900 ft
% Slope = 0.5
% Imperv = 95
N-Imperv = 0.014
N-Perv = 0.1
Dstore-Imperv = 0.175
Dstore-Perv = 0.175
%Zero-Imperv = 50
Subarea Routing = OUTLET
Percent Routed = 100
Infiltration = GREEN_AMPT
Groundwater = NO
LID Controls = 0
Land Uses = 0
Initial Buildup = NONE
Curb Length = 0

Lift #7 Area

Area = 7.114 acres
Width = 1200 ft
% Slope = 0.5
% Imperv = 95
N-Imperv = 0.014
N-Perv = 0.1
Dstore-Imperv = 0.175
Dstore-Perv = 0.175
%Zero-Imperv = 50
Subarea Routing = OUTLET
Percent Routed = 100
Infiltration = GREEN_AMPT
Groundwater = NO
LID Controls = 0
Land Uses = 0
Initial Buildup = NONE
Curb Length = 0

Attachment C

Attachment C (cont)

Standard 24-hour NRCS Rainfall Distributions

<i>time (hours)</i>	<i>type Ia 24-hour</i>	<i>Cummulative 1.25 in</i>	<i>Incremental 1.25 in</i>
0.0	0.00000	0	0
0.1	0.00224	0.0028	0.0028
0.2	0.00432	0.0054	0.0026
0.3	0.00628	0.00785	0.00245
0.4	0.00816	0.0102	0.00235
0.5	0.01000	0.0125	0.0023
0.6	0.01184	0.0148	0.0023
0.7	0.01372	0.01715	0.00235
0.8	0.01568	0.0196	0.00245
0.9	0.01776	0.0222	0.0026
1.0	0.02000	0.025	0.0028
1.1	0.02276	0.02845	0.00345
1.2	0.02568	0.0321	0.00365
1.3	0.02872	0.0359	0.0038
1.4	0.03184	0.0398	0.0039
1.5	0.03500	0.04375	0.00395
1.6	0.03797	0.0474625	0.0037125
1.7	0.04095	0.0511875	0.003725
1.8	0.04394	0.054925	0.0037375
1.9	0.04695	0.0586875	0.0037625
2.0	0.05000	0.0625	0.0038125
2.1	0.05315	0.0664375	0.0039375
2.2	0.05633	0.0704125	0.003975
2.3	0.05954	0.074425	0.0040125
2.4	0.06276	0.07845	0.004025
2.5	0.06600	0.0825	0.00405
2.6	0.06920	0.0865	0.004
2.7	0.07240	0.0905	0.004
2.8	0.07560	0.0945	0.004
2.9	0.07880	0.0985	0.004
3.0	0.08200	0.1025	0.004
3.1	0.08514	0.106425	0.003925
3.2	0.08829	0.1103625	0.0039375
3.3	0.09147	0.1143375	0.003975
3.4	0.09471	0.1183875	0.00405
3.5	0.09800	0.1225	0.0041125
3.6	0.10147	0.1268375	0.0043375
3.7	0.10502	0.131275	0.0044375
3.8	0.10862	0.135775	0.0045
3.9	0.11229	0.1403625	0.0045875

Attachment C

Standard 24-hour NRCS Rainfall Distributions

<i>time (hours)</i>	<i>type Ia 24-hour</i>	<i>Cummulative 1.25 in</i>	<i>Incremental 1.25 in</i>
4.0	0.11600	0.145	0.0046375
4.1	0.11969	0.1496125	0.0046125
4.2	0.12342	0.154275	0.0046625
4.3	0.12721	0.1590125	0.0047375
4.4	0.13107	0.1638375	0.004825
4.5	0.13500	0.16875	0.0049125
4.6	0.13901	0.1737625	0.0050125
4.7	0.14310	0.178875	0.0051125
4.8	0.14729	0.1841125	0.0052375
4.9	0.15159	0.1894875	0.005375
5.0	0.15600	0.195	0.0055125
5.1	0.16059	0.2007375	0.0057375
5.2	0.16530	0.206625	0.0058875
5.3	0.17011	0.2126375	0.0060125
5.4	0.17501	0.2187625	0.006125
5.5	0.18000	0.225	0.0062375
5.6	0.18494	0.231175	0.006175
5.7	0.18999	0.2374875	0.0063125
5.8	0.19517	0.2439625	0.006475
5.9	0.20049	0.2506125	0.00665
6.0	0.20600	0.2575	0.0068875
6.1	0.21196	0.26495	0.00745
6.2	0.21808	0.2726	0.00765
6.3	0.22432	0.2804	0.0078
6.4	0.23064	0.2883	0.0079
6.5	0.23700	0.29625	0.00795
6.6	0.24285	0.3035625	0.0073125
6.7	0.24878	0.310975	0.0074125
6.8	0.25490	0.318625	0.00765
6.9	0.26127	0.3265875	0.0079625
7.0	0.26800	0.335	0.0084125
7.1	0.27517	0.3439625	0.0089625
7.2	0.28287	0.3535875	0.009625
7.3	0.29118	0.363975	0.0103875
7.4	0.30019	0.3752375	0.0112625
7.5	0.31000	0.3875	0.0122625
7.6	0.33142	0.414275	0.026775
7.7	0.35469	0.4433625	0.0290875
7.8	0.37876	0.47345	0.0300875
7.9	0.40255	0.5031875	0.0297375

Attachment C

Standard 24-hour NRCS Rainfall Distributions

<i>time (hours)</i>	<i>type Ia 24-hour</i>	<i>Cummulative 1.25 in</i>	<i>Incremental 1.25 in</i>
8.0	0.42500	0.53125	0.0280625
8.1	0.43936	0.5492	0.01795
8.2	0.45168	0.5646	0.0154
8.3	0.46232	0.5779	0.0133
8.4	0.47164	0.58955	0.01165
8.5	0.48000	0.6	0.01045
8.6	0.48904	0.6113	0.0113
8.7	0.49752	0.6219	0.0106
8.8	0.50548	0.63185	0.00995
8.9	0.51296	0.6412	0.00935
9.0	0.52000	0.65	0.0088
9.1	0.52664	0.6583	0.0083
9.2	0.53292	0.66615	0.00785
9.3	0.53888	0.6736	0.00745
9.4	0.54456	0.6807	0.0071
9.5	0.55000	0.6875	0.0068
9.6	0.55564	0.69455	0.00705
9.7	0.56116	0.70145	0.0069
9.8	0.56656	0.7082	0.00675
9.9	0.57184	0.7148	0.0066
10.0	0.57700	0.72125	0.00645
10.1	0.58198	0.727475	0.006225
10.2	0.58685	0.7335625	0.0060875
10.3	0.59163	0.7395375	0.005975
10.4	0.59635	0.7454375	0.0059
10.5	0.60100	0.75125	0.0058125
10.6	0.60576	0.7572	0.00595
10.7	0.61044	0.76305	0.00585
10.8	0.61504	0.7688	0.00575
10.9	0.61956	0.77445	0.00565
11.0	0.62400	0.78	0.00555
11.1	0.62836	0.78545	0.00545
11.2	0.63264	0.7908	0.00535
11.3	0.63684	0.79605	0.00525
11.4	0.64096	0.8012	0.00515
11.5	0.64500	0.80625	0.00505
11.6	0.64889	0.8111125	0.0048625
11.7	0.65272	0.8159	0.0047875
11.8	0.65651	0.8206375	0.0047375
11.9	0.66026	0.825325	0.0046875

Attachment C

Standard 24-hour NRCS Rainfall Distributions

<i>time (hours)</i>	<i>type Ia 24-hour</i>	<i>Cummulative 1.25 in</i>	<i>Incremental 1.25 in</i>
12.0	0.66400	0.83	0.004675
12.1	0.66773	0.8346625	0.0046625
12.2	0.67148	0.83935	0.0046875
12.3	0.67527	0.8440875	0.0047375
12.4	0.67910	0.848875	0.0047875
12.5	0.68300	0.85375	0.004875
12.6	0.68665	0.8583125	0.0045625
12.7	0.69027	0.8628375	0.004525
12.8	0.69386	0.867325	0.0044875
12.9	0.69744	0.8718	0.004475
13.0	0.70100	0.87625	0.00445
13.1	0.70473	0.8809125	0.0046625
13.2	0.70838	0.885475	0.0045625
13.3	0.71198	0.889975	0.0045
13.4	0.71551	0.8943875	0.0044125
13.5	0.71900	0.89875	0.0043625
13.6	0.72245	0.9030625	0.0043125
13.7	0.72586	0.907325	0.0042625
13.8	0.72926	0.911575	0.00425
13.9	0.73263	0.9157875	0.0042125
14.0	0.73600	0.92	0.0042125
14.1	0.73939	0.9242375	0.0042375
14.2	0.74277	0.9284625	0.004225
14.3	0.74613	0.9326625	0.0042
14.4	0.74948	0.93685	0.0041875
14.5	0.75281	0.9410125	0.0041625
14.6	0.75613	0.9451625	0.00415
14.7	0.75943	0.9492875	0.004125
14.8	0.76271	0.9533875	0.0041
14.9	0.76598	0.957475	0.0040875
15.0	0.76924	0.96155	0.004075
15.1	0.77248	0.9656	0.00405
15.2	0.77571	0.9696375	0.0040375
15.3	0.77892	0.97365	0.0040125
15.4	0.78211	0.9776375	0.0039875
15.5	0.78529	0.9816125	0.003975
15.6	0.78845	0.9855625	0.00395
15.7	0.79160	0.9895	0.0039375
15.8	0.79474	0.993425	0.003925
15.9	0.79786	0.997325	0.0039

Attachment C

Standard 24-hour NRCS Rainfall Distributions

<i>time (hours)</i>	<i>type Ia 24-hour</i>	<i>Cummulative 1.25 in</i>	<i>Incremental 1.25 in</i>
16.0	0.80096	1.0012	0.003875
16.1	0.80405	1.0050625	0.0038625
16.2	0.80712	1.0089	0.0038375
16.3	0.81018	1.012725	0.003825
16.4	0.81322	1.016525	0.0038
16.5	0.81625	1.0203125	0.0037875
16.6	0.81926	1.024075	0.0037625
16.7	0.82226	1.027825	0.00375
16.8	0.82524	1.03155	0.003725
16.9	0.82821	1.0352625	0.0037125
17.0	0.83116	1.03895	0.0036875
17.1	0.83410	1.042625	0.003675
17.2	0.83702	1.046275	0.00365
17.3	0.83992	1.0499	0.003625
17.4	0.84281	1.0535125	0.0036125
17.5	0.84569	1.0571125	0.0036
17.6	0.84855	1.0606875	0.003575
17.7	0.85140	1.06425	0.0035625
17.8	0.85423	1.0677875	0.0035375
17.9	0.85704	1.0713	0.0035125
18.0	0.85984	1.0748	0.0035
18.1	0.86262	1.078275	0.003475
18.2	0.86539	1.0817375	0.0034625
18.3	0.86815	1.0851875	0.00345
18.4	0.87089	1.0886125	0.003425
18.5	0.87361	1.0920125	0.0034
18.6	0.87632	1.0954	0.0033875
18.7	0.87901	1.0987625	0.0033625
18.8	0.88169	1.1021125	0.00335
18.9	0.88435	1.1054375	0.003325
19.0	0.88700	1.10875	0.0033125
19.1	0.88963	1.1120375	0.0032875
19.2	0.89225	1.1153125	0.003275
19.3	0.89485	1.1185625	0.00325
19.4	0.89744	1.1218	0.0032375
19.5	0.90001	1.1250125	0.0032125
19.6	0.90257	1.1282125	0.0032
19.7	0.90511	1.1313875	0.003175
19.8	0.90763	1.1345375	0.00315
19.9	0.91014	1.137675	0.0031375

Attachment C

Standard 24-hour NRCS Rainfall Distributions

<i>time (hours)</i>	<i>type Ia 24-hour</i>	<i>Cummulative 1.25 in</i>	<i>Incremental 1.25 in</i>
20.0	0.91264	1.1408	0.003125
20.1	0.91512	1.1439	0.0031
20.2	0.91759	1.1469875	0.0030875
20.3	0.92004	1.15005	0.0030625
20.4	0.92247	1.1530875	0.0030375
20.5	0.92489	1.1561125	0.003025
20.6	0.92729	1.1591125	0.003
20.7	0.92968	1.1621	0.0029875
20.8	0.93206	1.165075	0.002975
20.9	0.93442	1.168025	0.00295
21.0	0.93676	1.17095	0.002925
21.1	0.93909	1.1738625	0.0029125
21.2	0.94140	1.17675	0.0028875
21.3	0.94370	1.179625	0.002875
21.4	0.94598	1.182475	0.00285
21.5	0.94825	1.1853125	0.0028375
21.6	0.95050	1.188125	0.0028125
21.7	0.95274	1.190925	0.0028
21.8	0.95496	1.1937	0.002775
21.9	0.95717	1.1964625	0.0027625
22.0	0.95936	1.1992	0.0027375
22.1	0.96154	1.201925	0.002725
22.2	0.96370	1.204625	0.0027
22.3	0.96584	1.2073	0.002675
22.4	0.96797	1.2099625	0.0026625
22.5	0.97009	1.2126125	0.00265
22.6	0.97219	1.2152375	0.002625
22.7	0.97428	1.21785	0.0026125
22.8	0.97635	1.2204375	0.0025875
22.9	0.97840	1.223	0.0025625
23.0	0.98044	1.22555	0.00255
23.1	0.98246	1.228075	0.002525
23.2	0.98447	1.2305875	0.0025125
23.3	0.98647	1.2330875	0.0025
23.4	0.98845	1.2355625	0.002475
23.5	0.99041	1.2380125	0.00245
23.6	0.99236	1.24045	0.0024375
23.7	0.99429	1.2428625	0.0024125
23.8	0.99621	1.2452625	0.0024
23.9	0.99811	1.2476375	0.002375
24.0	1.0000	1.25	0.0023625

Attachment C**Attachment C (cont)**

62,017 Peak Volume (gallon)

1.75 Peak Time (hrs)

Lift #1

591 Peak Flow (gpm)

SWMM Model Output

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
0.25	0.25	0.0052	35
0.5	0.25	0.0136	92
0.75	0.25	0.0292	197
1	0.25	0.039	263
1.25	0.25	0.0654	440
1.5	0.25	0.0792	533
1.75	0.25	0.106	714
2	0.25	0.1089	733
2.25	0.25	0.1307	880
2.5	0.25	0.1285	865
2.75	0.25	0.1464	986
3	0.25	0.1389	935
3.25	0.25	0.1528	1029
3.5	0.25	0.1432	964
3.75	0.25	0.1614	1087
4	0.25	0.1541	1037
4.25	0.25	0.1741	1172
4.5	0.25	0.1648	1109
4.75	0.25	0.1906	1283
5	0.25	0.2036	1371
5.25	0.25	0.2878	1937
5.5	0.25	0.3099	2086
5.75	0.25	0.3984	2682
6	0.25	0.3987	2684
6.25	0.25	0.5018	3378
6.5	0.25	0.4928	3318
6.75	0.25	0.5697	3835
7	0.25	0.5326	3585
7.25	0.25	0.6535	4399
7.5	0.25	0.6562	4418
7.75	0.25	1.3882	9345
8	0.25	1.5911	10711
8.25	0.25	1.6639	11201
8.5	0.25	1.1827	7962
8.75	0.25	1.082	7284

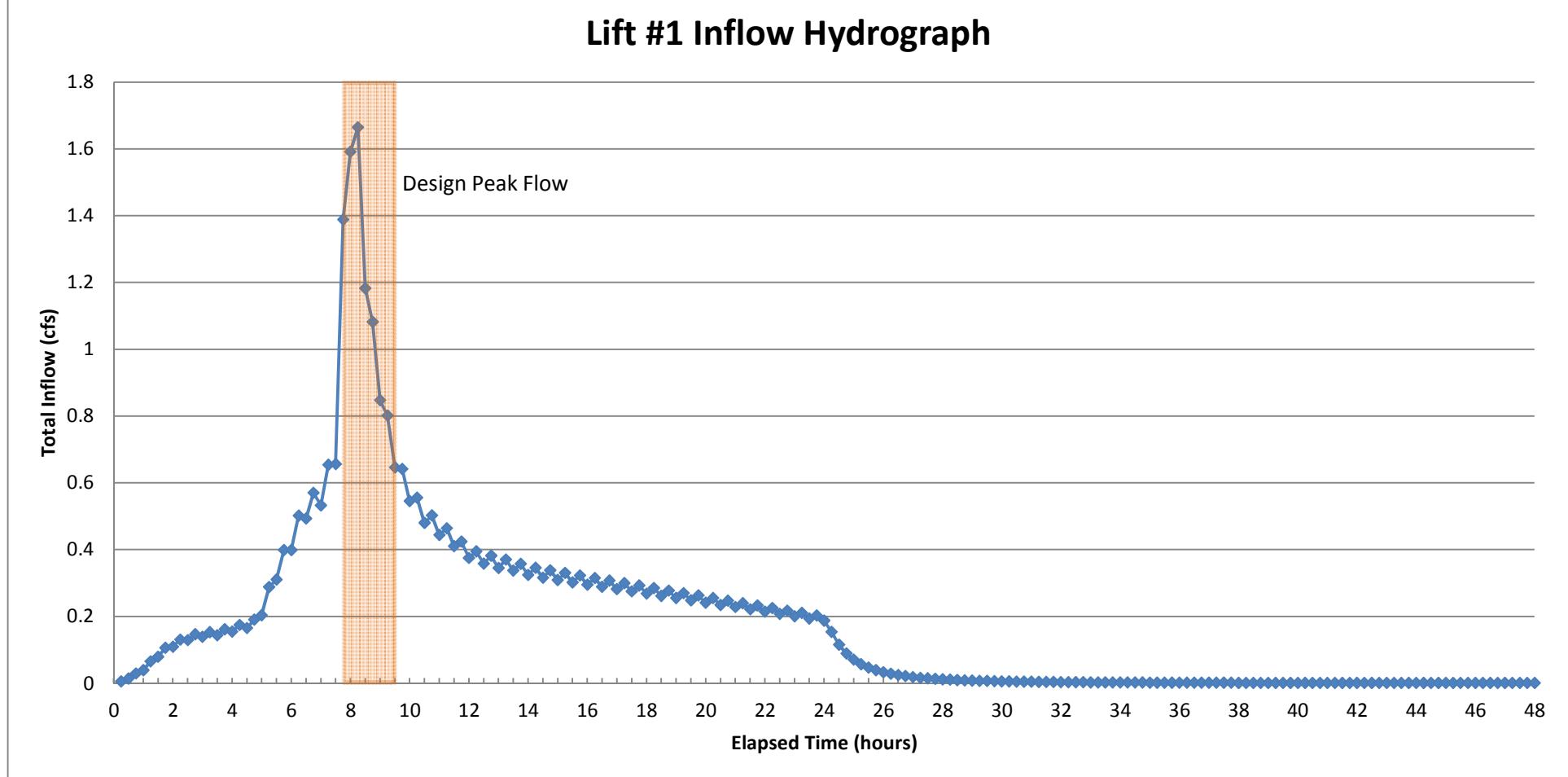
Attachment C

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
9	0.25	0.847	5702
9.25	0.25	0.8012	5394
9.5	0.25	0.6462	4350
9.75	0.25	0.6413	4317
10	0.25	0.5457	3674
10.25	0.25	0.5551	3737
10.5	0.25	0.4798	3230
10.75	0.25	0.502	3379
11	0.25	0.4436	2986
11.25	0.25	0.464	3124
11.5	0.25	0.4099	2759
11.75	0.25	0.4238	2853
12	0.25	0.3751	2525
12.25	0.25	0.3944	2655
12.5	0.25	0.3582	2411
12.75	0.25	0.3817	2570
13	0.25	0.3444	2319
13.25	0.25	0.3705	2494
13.5	0.25	0.3368	2267
13.75	0.25	0.357	2403
14	0.25	0.3237	2179
14.25	0.25	0.3457	2327
14.5	0.25	0.3158	2126
14.75	0.25	0.3377	2273
15	0.25	0.3088	2079
15.25	0.25	0.33	2222
15.5	0.25	0.3019	2032
15.75	0.25	0.3224	2170
16	0.25	0.2952	1987
16.25	0.25	0.3148	2119
16.5	0.25	0.2884	1942
16.75	0.25	0.3073	2069
17	0.25	0.2816	1896
17.25	0.25	0.2998	2018
17.5	0.25	0.2749	1851
17.75	0.25	0.2923	1968
18	0.25	0.2681	1805
18.25	0.25	0.2848	1917
18.5	0.25	0.2614	1760
18.75	0.25	0.2773	1867

Attachment C

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
19	0.25	0.2546	1714
19.25	0.25	0.2698	1816
19.5	0.25	0.2479	1669
19.75	0.25	0.2623	1766
20	0.25	0.2411	1623
20.25	0.25	0.2548	1715
20.5	0.25	0.2343	1577
20.75	0.25	0.2473	1665
21	0.25	0.2276	1532
21.25	0.25	0.2398	1614
21.5	0.25	0.2208	1486
21.75	0.25	0.2324	1565
22	0.25	0.214	1441
22.25	0.25	0.2249	1514
22.5	0.25	0.2072	1395
22.75	0.25	0.2174	1464
23	0.25	0.2005	1350
23.25	0.25	0.21	1414
23.5	0.25	0.1937	1304
23.75	0.25	0.2025	1363
24	0.25	0.1869	1258

Lift #1 Inflow Hydrograph



Attachment C**Attachment C (cont)**

57,562 Peak Volume (gallon)

1.75 Peak Time (hrs)

Lift #2

548 Peak Flow (gpm)

SWMM Model Output

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
0.25	0.25	0.0047	32
0.5	0.25	0.0125	84
0.75	0.25	0.0268	180
1	0.25	0.0358	241
1.25	0.25	0.0601	405
1.5	0.25	0.073	491
1.75	0.25	0.0977	658
2	0.25	0.1006	677
2.25	0.25	0.1208	813
2.5	0.25	0.119	801
2.75	0.25	0.1356	913
3	0.25	0.1287	866
3.25	0.25	0.1416	953
3.5	0.25	0.1329	895
3.75	0.25	0.1496	1007
4	0.25	0.143	963
4.25	0.25	0.1614	1087
4.5	0.25	0.1529	1029
4.75	0.25	0.1767	1190
5	0.25	0.1887	1270
5.25	0.25	0.266	1791
5.5	0.25	0.2867	1930
5.75	0.25	0.3684	2480
6	0.25	0.3692	2485
6.25	0.25	0.4645	3127
6.5	0.25	0.4568	3075
6.75	0.25	0.5279	3554
7	0.25	0.4942	3327
7.25	0.25	0.6057	4078
7.5	0.25	0.6087	4098
7.75	0.25	1.2828	8636
8	0.25	1.4737	9921
8.25	0.25	1.5436	10392
8.5	0.25	1.1006	7409
8.75	0.25	1.0065	6776

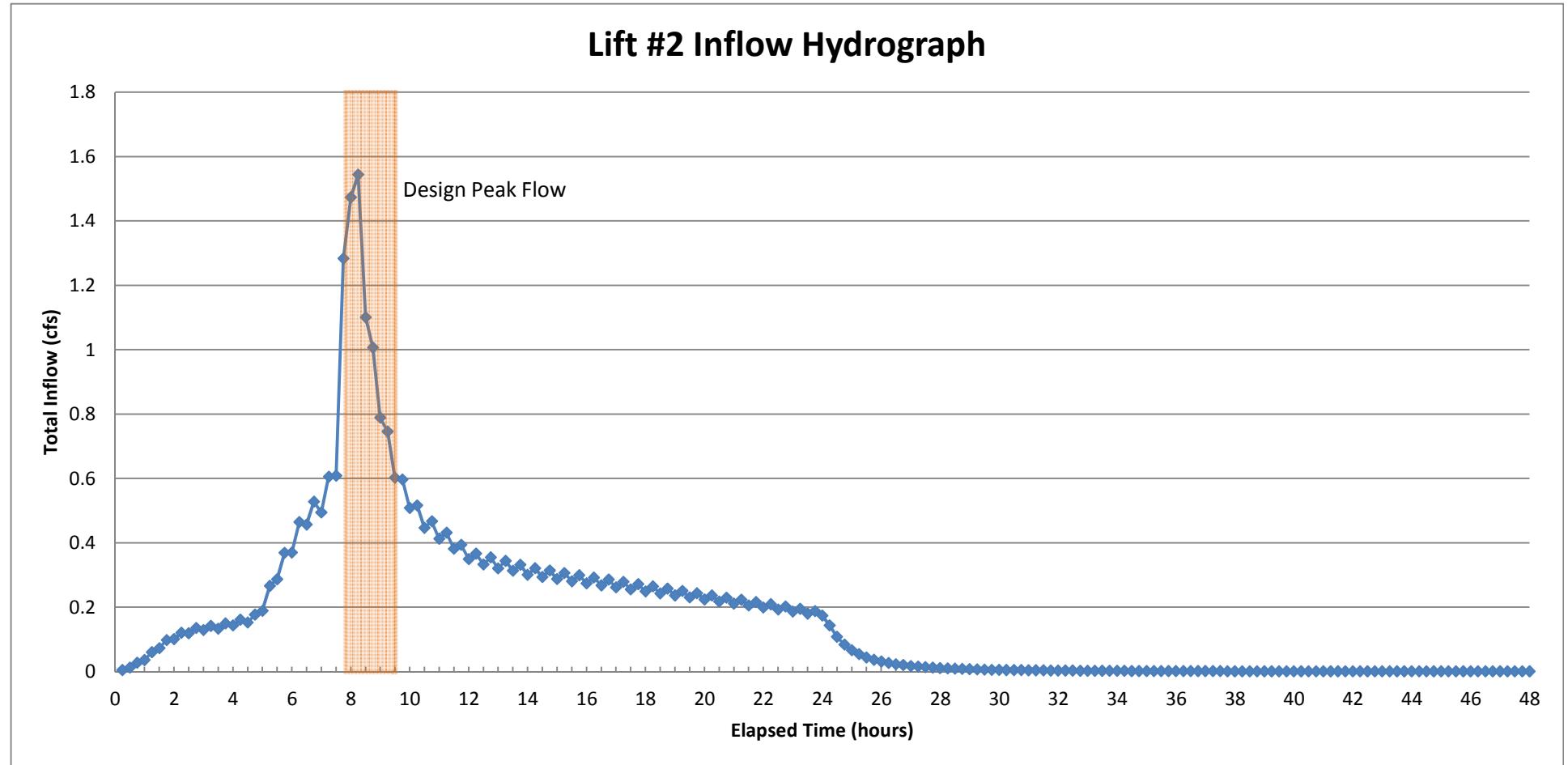
Attachment C

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
9	0.25	0.7889	5311
9.25	0.25	0.7457	5020
9.5	0.25	0.6019	4052
9.75	0.25	0.5967	4017
10	0.25	0.5081	3421
10.25	0.25	0.5162	3475
10.5	0.25	0.4465	3006
10.75	0.25	0.4666	3141
11	0.25	0.4126	2778
11.25	0.25	0.4312	2903
11.5	0.25	0.3812	2566
11.75	0.25	0.3938	2651
12	0.25	0.3489	2349
12.25	0.25	0.3664	2467
12.5	0.25	0.3331	2242
12.75	0.25	0.3546	2387
13	0.25	0.3202	2156
13.25	0.25	0.344	2316
13.5	0.25	0.313	2107
13.75	0.25	0.3316	2232
14	0.25	0.3009	2026
14.25	0.25	0.321	2161
14.5	0.25	0.2935	1976
14.75	0.25	0.3136	2111
15	0.25	0.287	1932
15.25	0.25	0.3064	2063
15.5	0.25	0.2806	1889
15.75	0.25	0.2994	2016
16	0.25	0.2743	1847
16.25	0.25	0.2923	1968
16.5	0.25	0.268	1804
16.75	0.25	0.2854	1921
17	0.25	0.2617	1762
17.25	0.25	0.2784	1874
17.5	0.25	0.2554	1719
17.75	0.25	0.2714	1827
18	0.25	0.2492	1678
18.25	0.25	0.2644	1780
18.5	0.25	0.2429	1635
18.75	0.25	0.2575	1733

Attachment C

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
19	0.25	0.2366	1593
19.25	0.25	0.2505	1686
19.5	0.25	0.2303	1550
19.75	0.25	0.2436	1640
20	0.25	0.224	1508
20.25	0.25	0.2366	1593
20.5	0.25	0.2178	1466
20.75	0.25	0.2297	1546
21	0.25	0.2115	1424
21.25	0.25	0.2227	1499
21.5	0.25	0.2052	1381
21.75	0.25	0.2158	1453
22	0.25	0.1989	1339
22.25	0.25	0.2089	1406
22.5	0.25	0.1926	1297
22.75	0.25	0.2019	1359
23	0.25	0.1863	1254
23.25	0.25	0.195	1313
23.5	0.25	0.18	1212
23.75	0.25	0.1881	1266
24	0.25	0.1737	1169

Lift #2 Inflow Hydrograph



Attachment C**Attachment C (cont)**

22,672 Peak Volume (gallon)

1.75 Peak Time (hrs)

Lift #3

216 Peak Flow (gpm)

SWMM Model Output

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
0.25	0.25	0.0023	15
0.5	0.25	0.006	40
0.75	0.25	0.0127	85
1	0.25	0.0164	110
1.25	0.25	0.0272	183
1.5	0.25	0.032	215
1.75	0.25	0.0422	284
2	0.25	0.0422	284
2.25	0.25	0.0503	339
2.5	0.25	0.0484	326
2.75	0.25	0.0552	372
3	0.25	0.0514	346
3.25	0.25	0.0568	382
3.5	0.25	0.0524	353
3.75	0.25	0.0597	402
4	0.25	0.0564	380
4.25	0.25	0.0644	434
4.5	0.25	0.0602	405
4.75	0.25	0.0707	476
5	0.25	0.0764	514
5.25	0.25	0.1115	751
5.5	0.25	0.1187	799
5.75	0.25	0.1532	1031
6	0.25	0.15	1010
6.25	0.25	0.1902	1280
6.5	0.25	0.1831	1233
6.75	0.25	0.2125	1431
7	0.25	0.195	1313
7.25	0.25	0.2434	1639
7.5	0.25	0.2415	1626
7.75	0.25	0.5391	3629
8	0.25	0.597	4019
8.25	0.25	0.6109	4113
8.5	0.25	0.4165	2804
8.75	0.25	0.3839	2584

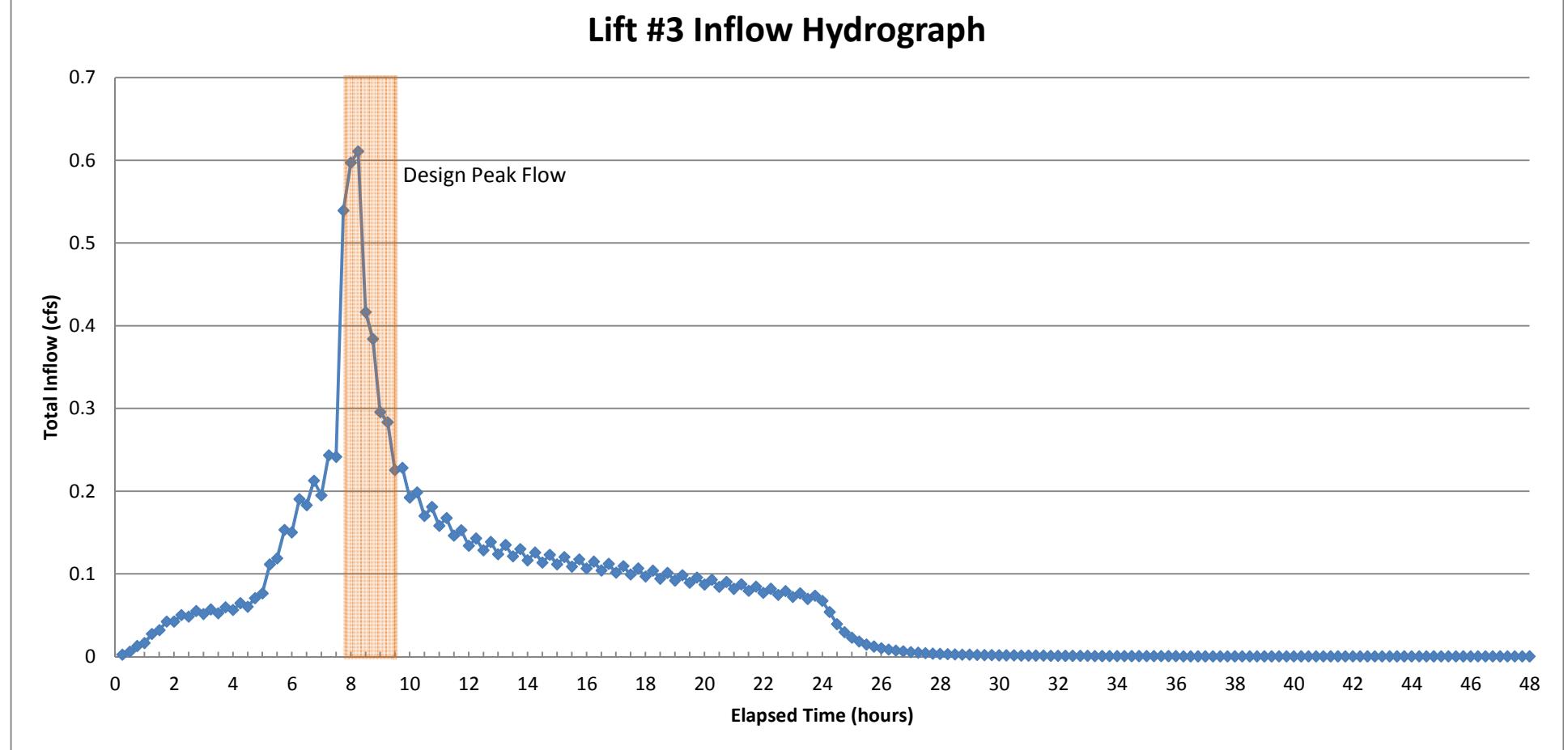
Attachment C

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
9	0.25	0.2955	1989
9.25	0.25	0.2834	1908
9.5	0.25	0.2255	1518
9.75	0.25	0.228	1535
10	0.25	0.1921	1293
10.25	0.25	0.1986	1337
10.5	0.25	0.1699	1144
10.75	0.25	0.1808	1217
11	0.25	0.1581	1064
11.25	0.25	0.1676	1128
11.5	0.25	0.1463	985
11.75	0.25	0.153	1030
12	0.25	0.1339	901
12.25	0.25	0.1427	961
12.5	0.25	0.1284	864
12.75	0.25	0.1386	933
13	0.25	0.1236	832
13.25	0.25	0.1348	907
13.5	0.25	0.1212	816
13.75	0.25	0.1299	874
14	0.25	0.1164	784
14.25	0.25	0.1258	847
14.5	0.25	0.1137	765
14.75	0.25	0.123	828
15	0.25	0.1113	749
15.25	0.25	0.1203	810
15.5	0.25	0.1088	732
15.75	0.25	0.1175	791
16	0.25	0.1064	716
16.25	0.25	0.1147	772
16.5	0.25	0.104	700
16.75	0.25	0.112	754
17	0.25	0.1015	683
17.25	0.25	0.1092	735
17.5	0.25	0.0991	667
17.75	0.25	0.1065	717
18	0.25	0.0967	651
18.25	0.25	0.1037	698
18.5	0.25	0.0942	634
18.75	0.25	0.101	680

Attachment C

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
19	0.25	0.0918	618
19.25	0.25	0.0982	661
19.5	0.25	0.0893	601
19.75	0.25	0.0955	643
20	0.25	0.0869	585
20.25	0.25	0.0927	624
20.5	0.25	0.0844	568
20.75	0.25	0.09	606
21	0.25	0.082	552
21.25	0.25	0.0873	588
21.5	0.25	0.0795	535
21.75	0.25	0.0845	569
22	0.25	0.0771	519
22.25	0.25	0.0818	551
22.5	0.25	0.0746	502
22.75	0.25	0.079	532
23	0.25	0.0722	486
23.25	0.25	0.0763	514
23.5	0.25	0.0697	469
23.75	0.25	0.0736	495
24	0.25	0.0673	453

Lift #3 Inflow Hydrograph



Attachment C**Attachment C (cont)**

22,384 Peak Volume (gallon)

1.75 Peak Time (hrs)

Lift #4

213 Peak Flow (gpm)

SWMM Model Output

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
0.25	0.25	0.0023	15
0.5	0.25	0.006	40
0.75	0.25	0.0126	85
1	0.25	0.0163	110
1.25	0.25	0.027	182
1.5	0.25	0.0318	214
1.75	0.25	0.0418	281
2	0.25	0.0417	281
2.25	0.25	0.0498	335
2.5	0.25	0.0479	322
2.75	0.25	0.0546	368
3	0.25	0.0508	342
3.25	0.25	0.0561	378
3.5	0.25	0.0517	348
3.75	0.25	0.059	397
4	0.25	0.0557	375
4.25	0.25	0.0636	428
4.5	0.25	0.0594	400
4.75	0.25	0.0699	471
5	0.25	0.0755	508
5.25	0.25	0.1104	743
5.5	0.25	0.1175	791
5.75	0.25	0.1516	1021
6	0.25	0.1484	999
6.25	0.25	0.1881	1266
6.5	0.25	0.1809	1218
6.75	0.25	0.21	1414
7	0.25	0.1925	1296
7.25	0.25	0.2406	1620
7.5	0.25	0.2386	1606
7.75	0.25	0.5341	3596
8	0.25	0.5902	3973
8.25	0.25	0.6032	4061
8.5	0.25	0.4102	2761
8.75	0.25	0.3784	2547

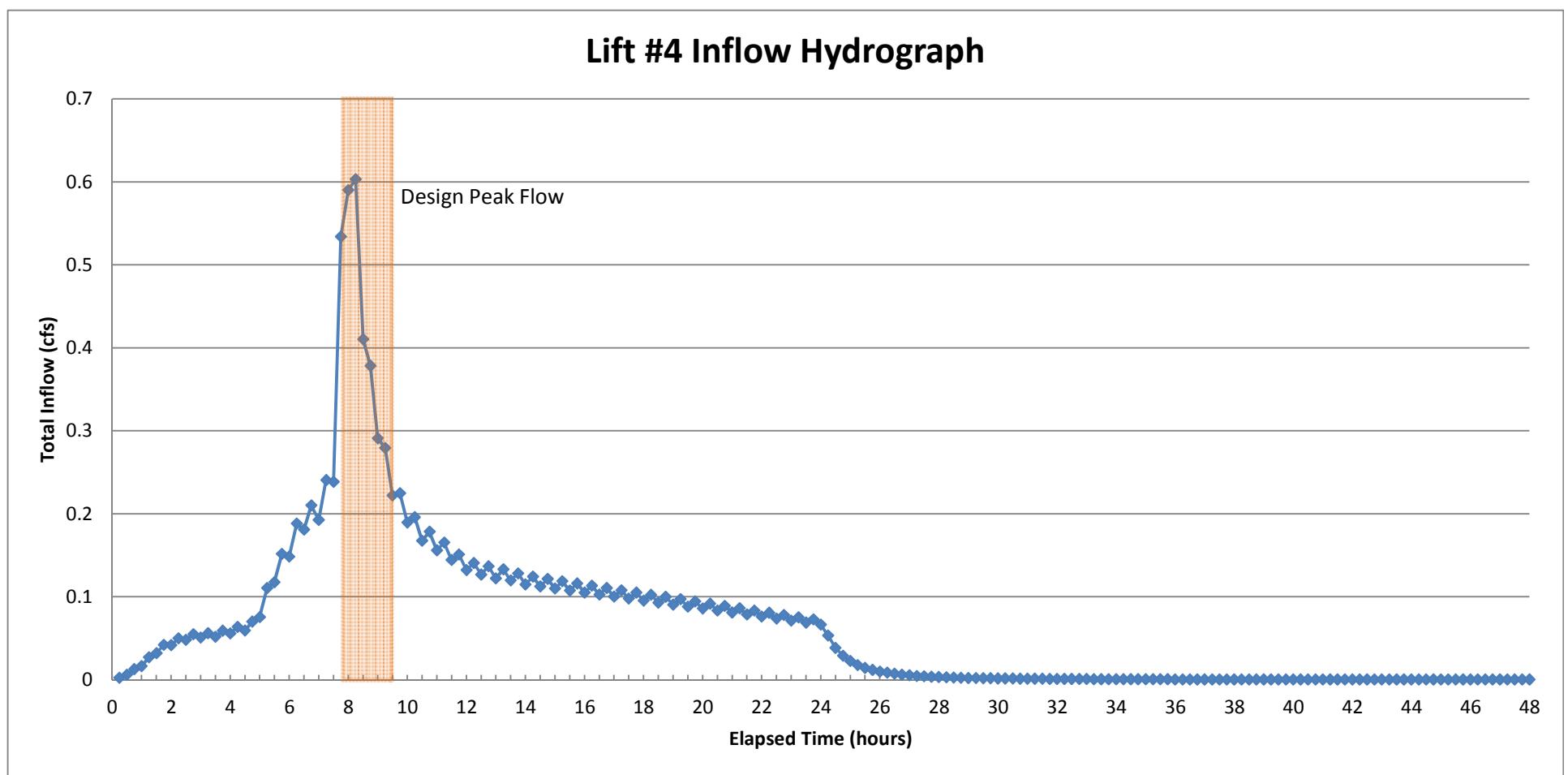
Attachment C

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
9	0.25	0.291	1959
9.25	0.25	0.2793	1880
9.5	0.25	0.2221	1495
9.75	0.25	0.2248	1513
10	0.25	0.1893	1274
10.25	0.25	0.1959	1319
10.5	0.25	0.1674	1127
10.75	0.25	0.1784	1201
11	0.25	0.1558	1049
11.25	0.25	0.1654	1113
11.5	0.25	0.1443	971
11.75	0.25	0.151	1017
12	0.25	0.132	889
12.25	0.25	0.1408	948
12.5	0.25	0.1266	852
12.75	0.25	0.1368	921
13	0.25	0.122	821
13.25	0.25	0.1331	896
13.5	0.25	0.1196	805
13.75	0.25	0.1282	863
14	0.25	0.1149	774
14.25	0.25	0.1242	836
14.5	0.25	0.1122	755
14.75	0.25	0.1215	818
15	0.25	0.1098	739
15.25	0.25	0.1187	799
15.5	0.25	0.1074	723
15.75	0.25	0.116	781
16	0.25	0.105	707
16.25	0.25	0.1133	763
16.5	0.25	0.1026	691
16.75	0.25	0.1106	745
17	0.25	0.1002	675
17.25	0.25	0.1078	726
17.5	0.25	0.0978	658
17.75	0.25	0.1051	708
18	0.25	0.0954	642
18.25	0.25	0.1024	689
18.5	0.25	0.0929	625
18.75	0.25	0.0997	671

Attachment C

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
19	0.25	0.0905	609
19.25	0.25	0.097	653
19.5	0.25	0.0881	593
19.75	0.25	0.0943	635
20	0.25	0.0857	577
20.25	0.25	0.0916	617
20.5	0.25	0.0833	561
20.75	0.25	0.0888	598
21	0.25	0.0809	545
21.25	0.25	0.0861	580
21.5	0.25	0.0785	528
21.75	0.25	0.0834	561
22	0.25	0.0761	512
22.25	0.25	0.0807	543
22.5	0.25	0.0736	495
22.75	0.25	0.078	525
23	0.25	0.0712	479
23.25	0.25	0.0753	507
23.5	0.25	0.0688	463
23.75	0.25	0.0726	489
24	0.25	0.0664	447

Lift #4 Inflow Hydrograph



Attachment C

Attachment C (cont) **9,929 Peak Volume (gallon)**
Lift #5 **1.75 Peak Time (hrs)**
SWMM Model Output **95 Peak Flow (gpm)**

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
0.25	0.25	0.001	7
0.5	0.25	0.0025	17
0.75	0.25	0.0053	36
1	0.25	0.0069	46
1.25	0.25	0.0114	77
1.5	0.25	0.0136	92
1.75	0.25	0.018	121
2	0.25	0.0182	123
2.25	0.25	0.0217	146
2.5	0.25	0.021	141
2.75	0.25	0.0239	161
3	0.25	0.0224	151
3.25	0.25	0.0247	166
3.5	0.25	0.023	155
3.75	0.25	0.026	175
4	0.25	0.0247	166
4.25	0.25	0.0281	189
4.5	0.25	0.0264	178
4.75	0.25	0.0308	207
5	0.25	0.0332	224
5.25	0.25	0.0479	322
5.5	0.25	0.0512	345
5.75	0.25	0.066	444
6	0.25	0.0652	439
6.25	0.25	0.0824	555
6.5	0.25	0.0798	537
6.75	0.25	0.0925	623
7	0.25	0.0854	575
7.25	0.25	0.106	714
7.5	0.25	0.1056	711
7.75	0.25	0.2316	1559
8	0.25	0.2595	1747
8.25	0.25	0.2673	1799
8.5	0.25	0.1846	1243
8.75	0.25	0.1697	1142

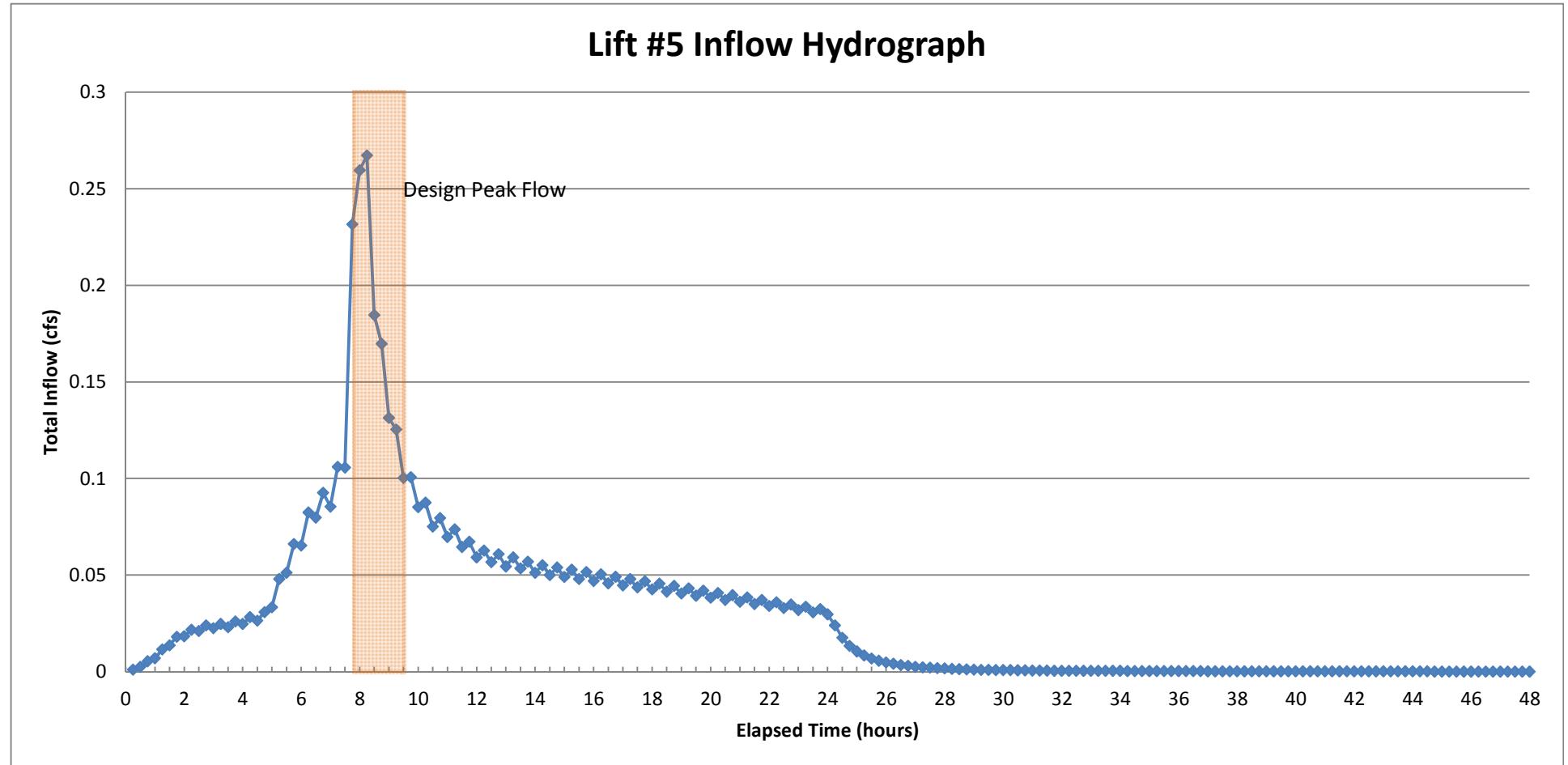
Attachment C

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
9	0.25	0.1313	884
9.25	0.25	0.1253	844
9.5	0.25	0.1002	675
9.75	0.25	0.1006	677
10	0.25	0.0851	573
10.25	0.25	0.0875	589
10.5	0.25	0.0751	506
10.75	0.25	0.0795	535
11	0.25	0.0697	469
11.25	0.25	0.0736	495
11.5	0.25	0.0645	434
11.75	0.25	0.0672	452
12	0.25	0.0591	398
12.25	0.25	0.0626	421
12.5	0.25	0.0566	381
12.75	0.25	0.0608	409
13	0.25	0.0544	366
13.25	0.25	0.0591	398
13.5	0.25	0.0533	359
13.75	0.25	0.0569	383
14	0.25	0.0512	345
14.25	0.25	0.0551	371
14.5	0.25	0.05	337
14.75	0.25	0.0539	363
15	0.25	0.0489	329
15.25	0.25	0.0527	355
15.5	0.25	0.0479	322
15.75	0.25	0.0515	347
16	0.25	0.0468	315
16.25	0.25	0.0503	339
16.5	0.25	0.0457	308
16.75	0.25	0.0491	331
17	0.25	0.0446	300
17.25	0.25	0.0479	322
17.5	0.25	0.0436	294
17.75	0.25	0.0467	314
18	0.25	0.0425	286
18.25	0.25	0.0455	306
18.5	0.25	0.0414	279
18.75	0.25	0.0443	298

Attachment C

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
19	0.25	0.0404	272
19.25	0.25	0.0431	290
19.5	0.25	0.0393	265
19.75	0.25	0.0419	282
20	0.25	0.0382	257
20.25	0.25	0.0407	274
20.5	0.25	0.0371	250
20.75	0.25	0.0395	266
21	0.25	0.0361	243
21.25	0.25	0.0383	258
21.5	0.25	0.035	236
21.75	0.25	0.0371	250
22	0.25	0.0339	228
22.25	0.25	0.0359	242
22.5	0.25	0.0328	221
22.75	0.25	0.0347	234
23	0.25	0.0318	214
23.25	0.25	0.0335	226
23.5	0.25	0.0307	207
23.75	0.25	0.0323	217
24	0.25	0.0296	199

Lift #5 Inflow Hydrograph



Attachment C

Attachment C (cont) **39,581 Peak Volume (gallon)**
Lift #6 **1.75 Peak Time (hrs)**
SWMM Model Output **377 Peak Flow (gpm)**

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
0.25	0.25	0.0083	56
0.5	0.25	0.0191	129
0.75	0.25	0.0364	245
1	0.25	0.0417	281
1.25	0.25	0.0663	446
1.5	0.25	0.0705	475
1.75	0.25	0.09	606
2	0.25	0.0818	551
2.25	0.25	0.0984	662
2.5	0.25	0.0883	594
2.75	0.25	0.1031	694
3	0.25	0.0903	608
3.25	0.25	0.1032	695
3.5	0.25	0.0905	609
3.75	0.25	0.109	734
4	0.25	0.0983	662
4.25	0.25	0.1179	794
4.5	0.25	0.1047	705
4.75	0.25	0.1323	891
5	0.25	0.1491	1004
5.25	0.25	0.239	1609
5.5	0.25	0.2355	1585
5.75	0.25	0.307	2067
6	0.25	0.2762	1859
6.25	0.25	0.3661	2465
6.5	0.25	0.327	2201
6.75	0.25	0.3918	2638
7	0.25	0.3363	2264
7.25	0.25	0.4547	3061
7.5	0.25	0.4279	2881
7.75	0.25	1.1513	7751
8	0.25	1.0841	7298
8.25	0.25	1.0498	7067
8.5	0.25	0.6271	4222
8.75	0.25	0.6227	4192

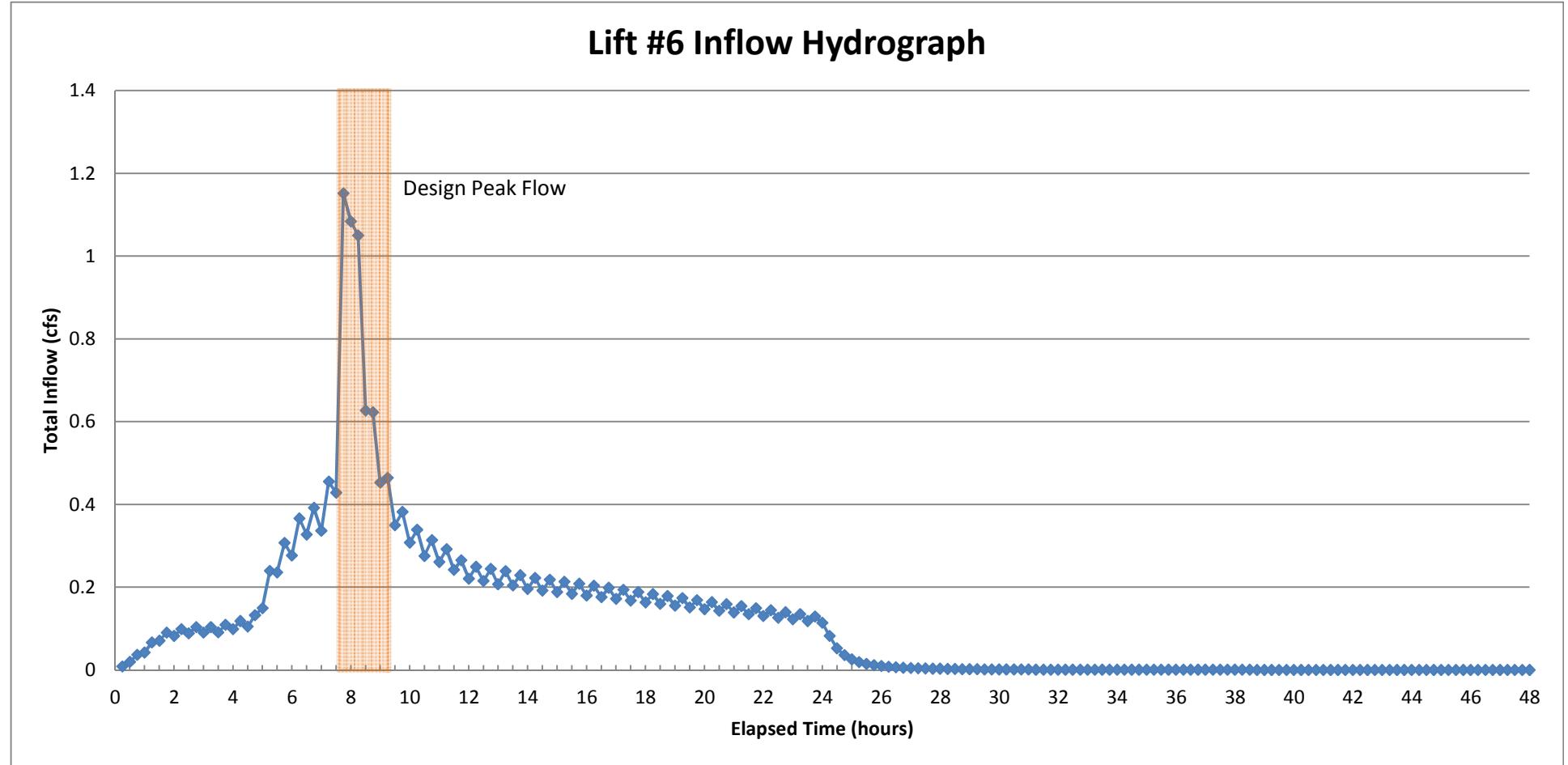
Attachment C

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
9	0.25	0.4525	3046
9.25	0.25	0.4641	3124
9.5	0.25	0.3496	2354
9.75	0.25	0.382	2572
10	0.25	0.3074	2069
10.25	0.25	0.3388	2281
10.5	0.25	0.2754	1854
10.75	0.25	0.3134	2110
11	0.25	0.2604	1753
11.25	0.25	0.2918	1964
11.5	0.25	0.2415	1626
11.75	0.25	0.2651	1785
12	0.25	0.2206	1485
12.25	0.25	0.2489	1676
12.5	0.25	0.2147	1445
12.75	0.25	0.2442	1644
13	0.25	0.207	1394
13.25	0.25	0.2389	1608
13.5	0.25	0.2041	1374
13.75	0.25	0.2292	1543
14	0.25	0.1955	1316
14.25	0.25	0.2224	1497
14.5	0.25	0.1917	1291
14.75	0.25	0.218	1468
15	0.25	0.1879	1265
15.25	0.25	0.2132	1435
15.5	0.25	0.1839	1238
15.75	0.25	0.2082	1402
16	0.25	0.1798	1210
16.25	0.25	0.2033	1369
16.5	0.25	0.1757	1183
16.75	0.25	0.1983	1335
17	0.25	0.1716	1155
17.25	0.25	0.1934	1302
17.5	0.25	0.1675	1128
17.75	0.25	0.1884	1268
18	0.25	0.1634	1100
18.25	0.25	0.1835	1235
18.5	0.25	0.1593	1072
18.75	0.25	0.1786	1202

Attachment C

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
19	0.25	0.1552	1045
19.25	0.25	0.1736	1169
19.5	0.25	0.151	1017
19.75	0.25	0.1687	1136
20	0.25	0.1469	989
20.25	0.25	0.1638	1103
20.5	0.25	0.1428	961
20.75	0.25	0.1588	1069
21	0.25	0.1386	933
21.25	0.25	0.1539	1036
21.5	0.25	0.1345	905
21.75	0.25	0.149	1003
22	0.25	0.1303	877
22.25	0.25	0.144	969
22.5	0.25	0.1262	850
22.75	0.25	0.1391	936
23	0.25	0.122	821
23.25	0.25	0.1342	903
23.5	0.25	0.1178	793
23.75	0.25	0.1293	870
24	0.25	0.1136	765

Lift #6 Inflow Hydrograph



Attachment C

Attachment X (cont) **52,758 Peak Volume (gallon)**
Lift #7 **1.75 Peak Time (hrs)**
502 Peak Flow (gpm)

SWMM Model Output

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
0.25	0.25	0.011	74
0.5	0.25	0.0254	171
0.75	0.25	0.0485	327
1	0.25	0.0555	374
1.25	0.25	0.0884	595
1.5	0.25	0.0939	632
1.75	0.25	0.1199	807
2	0.25	0.109	734
2.25	0.25	0.1311	883
2.5	0.25	0.1177	792
2.75	0.25	0.1375	926
3	0.25	0.1204	811
3.25	0.25	0.1376	926
3.5	0.25	0.1207	813
3.75	0.25	0.1454	979
4	0.25	0.1311	883
4.25	0.25	0.1572	1058
4.5	0.25	0.1395	939
4.75	0.25	0.1764	1188
5	0.25	0.1987	1338
5.25	0.25	0.3186	2145
5.5	0.25	0.3139	2113
5.75	0.25	0.4092	2755
6	0.25	0.3682	2479
6.25	0.25	0.488	3285
6.5	0.25	0.4358	2934
6.75	0.25	0.5222	3515
7	0.25	0.4483	3018
7.25	0.25	0.6062	4081
7.5	0.25	0.5703	3839
7.75	0.25	1.5347	10332
8	0.25	1.4451	9728
8.25	0.25	1.3993	9420
8.5	0.25	0.8358	5627
8.75	0.25	0.83	5588

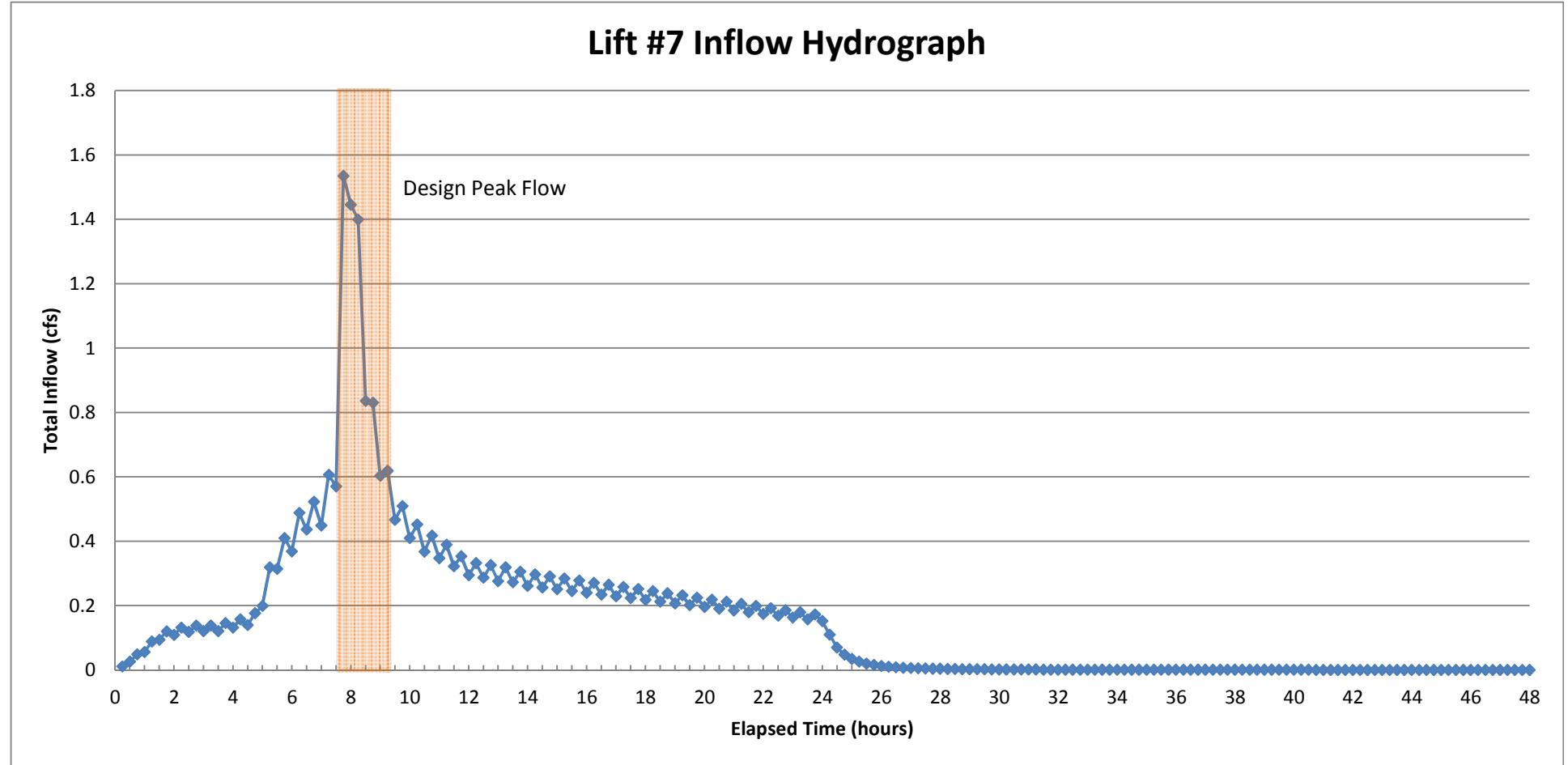
Attachment C

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
9	0.25	0.6031	4060
9.25	0.25	0.6186	4164
9.5	0.25	0.466	3137
9.75	0.25	0.5092	3428
10	0.25	0.4097	2758
10.25	0.25	0.4516	3040
10.5	0.25	0.3671	2471
10.75	0.25	0.4177	2812
11	0.25	0.3471	2337
11.25	0.25	0.3889	2618
11.5	0.25	0.3218	2166
11.75	0.25	0.3533	2378
12	0.25	0.294	1979
12.25	0.25	0.3318	2234
12.5	0.25	0.2862	1927
12.75	0.25	0.3254	2191
13	0.25	0.2759	1857
13.25	0.25	0.3185	2144
13.5	0.25	0.2721	1832
13.75	0.25	0.3055	2057
14	0.25	0.2606	1754
14.25	0.25	0.2965	1996
14.5	0.25	0.2556	1721
14.75	0.25	0.2906	1956
15	0.25	0.2504	1686
15.25	0.25	0.2841	1913
15.5	0.25	0.2451	1650
15.75	0.25	0.2776	1869
16	0.25	0.2396	1613
16.25	0.25	0.271	1824
16.5	0.25	0.2342	1577
16.75	0.25	0.2644	1780
17	0.25	0.2287	1540
17.25	0.25	0.2578	1736
17.5	0.25	0.2233	1503
17.75	0.25	0.2512	1691
18	0.25	0.2178	1466
18.25	0.25	0.2446	1647
18.5	0.25	0.2123	1429
18.75	0.25	0.238	1602

Attachment C

<i>Time (hrs)</i>	<i>Incremental Time (hrs)</i>	<i>Incremental Inflow (CFS)</i>	<i>Incremental Volume (gallons)</i>
19	0.25	0.2068	1392
19.25	0.25	0.2314	1558
19.5	0.25	0.2013	1355
19.75	0.25	0.2248	1513
20	0.25	0.1958	1318
20.25	0.25	0.2183	1470
20.5	0.25	0.1903	1281
20.75	0.25	0.2117	1425
21	0.25	0.1848	1244
21.25	0.25	0.2051	1381
21.5	0.25	0.1793	1207
21.75	0.25	0.1986	1337
22	0.25	0.1737	1169
22.25	0.25	0.192	1293
22.5	0.25	0.1682	1132
22.75	0.25	0.1855	1249
23	0.25	0.1626	1095
23.25	0.25	0.1789	1204
23.5	0.25	0.157	1057
23.75	0.25	0.1724	1161
24	0.25	0.1515	1020

Lift #7 Inflow Hydrograph



Attachment D
Phase 3 Hydraulic Design
Modeling

ATTACHMENT D - Vigor Industrial Stormwater Lift Station Pump Design Calculations - REV 06/09/15

Lift Station / Pipe run	#2	#7	#2/#7 to #3	#3	#2/#3 to #4	#4	#2/3/4 to #1/6	#1	#1/2/3/4 to #6	#6	Combined Flow to Bioretention Pond
Drain Area											
Peak runoff, GPM	692	688		274		270		746		516	
Dual Pump Design, GPM (7)	650	650	1300	250	1550	250	1800	700	2500	500	3000
Single Pump rate, GPM (1)	325	325		125		125		350		250	
Rim El, ft	37	31.91		37		37		35.5		37	40
Pump intake El, ft	23	18.5	30	23	31.5	23	31.5	21.5	31.5	23	31.5
Design Water Level, ft (4)	25	20.5		25		25		23.5		25	
Run length, ft (6)			1069	30	366	30	200	283	563	210	1130
Nom Diameter (SCH80 PVC)	6	6	10	3	10	3	10	6	12	4	14
Actual Diameter, in. (3)	5.761	5.761	9.564	2.9	9.564	2.9	9.564	5.761	11.376	3.826	12.5
Velocity, dual pump, ft/s	8.00	8.00	5.81	n/a	6.92	n/a	8.04	8.62	7.89	n/a	7.84
Velocity, single pump, ft/s	4.00	4.00	n/a	6.07	n/a	6.07		4.31		6.98	
Dual Pump Hydraulics (2)(5)											
Static loss	89.12	93.62	66.74	71.74	55.8	62.3	47.38	55.38	32.92	39.42	8.5
Piping loss	4.75	4.75	15.55	2.54	7.37	2.54	5.3	15.41	11.76	6.14	20.95
fitting loss	5.17	5.17	1.83	1.69	2.07	1.68	3.12	5.72	2.7	2.51	3.47
Total loss	99.04	103.54	84.12	75.97	65.24	66.52	55.8	76.51	47.38	48.07	32.92
Pump design - all pumps											
FLOW RATE, GPM	325	325		125		125		350		250	
NUMBER OF PUMPS	2	2		2		2		2		2	
TOTAL FLOW RATE, GPM	650	650		250		250		700		500	3000
HEAD (TDH), Ft	99.04	103.54		75.97		66.52		76.51		48.07	

Calculation Notes / Assumptions

- "Single" pump flow is the contribution of one pump when both are operating. If only one pump is operating (lead pump) then the rate of that pump will be higher.
- Pipe roughness is set at 120 (steel pipe) which is more conservative than for PVC.
- Pipe diameters based on SCH80 wall thickness -- if a thinner wall pipe is used then dynamic losses will be lower.
- Pump inlet water elevation assumed to be 2' above the pump intake, or 3' above the bottom of the manhole.
- HYDROFLO pump hydraulics program; based on Hazen-Williams equation; water at ambient temperature.
- Pipe lengths taken from "MLB_working site Plan-Model-Pipe Lengths.pdf"
- Pump out rate allows for no more than ~ 500 gallons accumulation at peak of storm event